

IN THE UNITED STATES DISTRICT COURT FOR THE
SOUTHERN DISTRICT OF WEST VIRGINIA

THE CITY OF HUNTINGTON,

Plaintiff,

v.

AMERISOURCEBERGEN DRUG
CORPORATION, et al.,

Defendants.

Civil Action No. 3:17-01362
Hon. David A. Faber

CABELL COUNTY COMMISSION,

Plaintiff,

v.

AMERISOURCEBERGEN DRUG
CORPORATION, et al.,

Defendants.

Civil Action No. 3:17-01655
Hon. David A. Faber

SUPPLEMENTAL APPENDIX TO
REPLY IN SUPPORT OF DEFENDANTS' MOTION TO EXCLUDE
CERTAIN EXPERT TESTIMONY OF KATHERINE KEYES

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November 19, 2020

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v. CIVIL ACTION NO. 3:17-01362

AMERISOURCEBERGEN DRUG
CORPORATION, et al,
Defendants.

CABELL COUNTY COMMISSION,
Plaintiff,

vs.

AMERISOURCEBERGEN DRUG
CORPORATION, et al,
Defendants.

Videotaped and videoconference deposition of
KATHERINE KEYES, taken by the Defendants pursuant to the
West Virginia Federal Rules of Civil Procedure, in the
above-entitled action, pursuant to notice, conducted
virtually via Zoom, before Twyla Donathan, Registered
Professional Reporter and Notary Public, on the 30th day
of October, 2020.

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3 EXAMINATION OF KATHERINE KEYES PAGE

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5 By Mr. Metz 6 .

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9 E X H I B I T S

10

11 (Attached to the transcript)

12

13 DESCRIPTION OF EXHIBITS PAGE

14

15 Exhibit No. 1 Keyes Report 10

16 Exhibit No. 6 Fentanyl Sensitivity Analysis 12

17 Exhibit No. 4 First Errata Submitted August 24, 30

18 2020

19 Exhibit No. 2 Keyes Katherine MDL CT2 input 34

20 calculations

21 Exhibit No. 10 Keyes Katherine MDL CT2 Input 34

22 Calculations XLSX

23 Exhibit No. 12 "Second Errata" 60

24 Exhibit No. 14 "Exhibit 10 to Davies' deposition" 124

1 estimate the deaths directly and indirectly
2 attributable to prescription opioids.

3 Q Okay. Exhibit 6 was provided to us after
4 your first deposition, and it bears the title
5 "Fentanyl Sensitivity Analysis.XLSX."

6 Is it fair to say that this file contains
7 the sensitivity analyses that you testified about at
8 your first deposition?

9 A Yes.

10 Q When was this file created?

11 A I created this file after the deposition to
12 kind of organize the sensitivity analyses that were
13 done. The calculations had been performed
14 previously.

15 Q Okay. So previously they existed in some
16 other sets of files, and you created this one file to
17 collect them together; is that fair?

18 A That's fair.

19 Q Did you make any changes to your
20 calculations in the course of preparing this file?

21 A I added the assumed average number of
22 prescription fentanyl deaths per year column, just
23 for completeness.

24 Q Those are Columns T through V?

1 A Yes.

2 Q So Column T through V did not exist in any
3 form until after you were deposed?

4 A Yes.

5 Q Now, I think you told me just a moment ago
6 you did that for completeness. What do you mean by
7 that?

8 A Because I had performed those calculations,
9 and so I thought that they formed a complete set of
10 all the calculations that I had performed. And so I
11 felt it appropriate to add them to the kind of range
12 of estimates that I performed for this fentanyl
13 sensitivity analysis.

14 Q You performed those calculations when?

15 A Which? The --

16 Q T through V.

17 A I don't know the specific date.

18 Q Was it prior to the service of your report
19 on August 3rd?

20 A No.

21 Q Was it prior to the -- sorry. Bear with
22 me. Was it prior to the disclosure of your first
23 report errata on August 24th?

24 A No.

1 Q Was it prior to your deposition on
2 September 15th?

3 A No.

4 Q It was after your deposition?

5 A Yes.

6 Q Now, I want to make sure I understand how
7 this information was all put together. So I just
8 want to walk you through this a little bit.

9 Starting in Column D, you grouped together
10 some statistics for overdose deaths that are coded as
11 involving any of the code -- it's T40.2, T40.3,
12 T40.4. Do you see that?

13 A Yes.

14 Q Now, T40.2 refers to natural or
15 semi-synthetic opioids, such as oxycodone or
16 hydrocodone, correct?

17 A Yes, those would be examples.

18 Q So if, for simplicity, I refer to that
19 category throughout the day as prescription opioid
20 pills, will you understand that I am referring by
21 that term to this T40.2 designation?

22 A I don't think that's an accurate
23 characterization of T40.2. I wonder if we could just
24 say T40.2?

1 A Yes. Just to be clear, a death is in
2 Column D if the death certificate codes T40.2, T40.3
3 or T40.4.

4 Q Were present?

5 A That's correct. Or coded.

6 Q Or coded. And that -- in your methodology,
7 that remains true even if the code for heroin is also
8 present, correct?

9 A That's right.

10 Q Have you ever investigated how many of the
11 overdose deaths that you have coded in this
12 prescription opioid column also had heroin present at
13 the time of death?

14 A I've looked at that, yes.

15 Q You have looked at that number? Did you
16 make a note of what that number was?

17 A Not in this spreadsheet.

18 Q Nor in your report, correct?

19 A That's correct. It was not informative to
20 my methodology.

21 Q As you sit here, do you have a general
22 sense of how many of those deaths that you coded as a
23 prescription-opioid-involved death also involved
24 heroin?

1 deaths that had T40.4 coded that didn't have
2 additionally T40.2 or T40.3.

3 Q Okay. Are there any other categories of
4 prescription opioids that have a different code from
5 T40.2, T40.3 or T40.4?

6 A I just want to be very clear about the
7 methodology. So that's what that column represents.

8 Q Okay. I think I understand your answer.

9 And so in Column F the only exclusion you
10 were making was for T40.2 or T40.3. And so the
11 deaths that are listed in Column F, those can also
12 include deaths where heroin was a contributing
13 factor, correct?

14 A That's correct.

15 Q And have you investigated at any point how
16 many of those deaths also involved heroin?

17 A I mean, a similar answer is the previous
18 answer. It was not informative to this methodology,
19 but I have looked at all kinds of combinations of the
20 T codes for various purposes in the past.

21 Q Okay. For purposes of determining a number
22 of overdose deaths caused directly by prescription
23 opioids, you weren't interested in knowing how many
24 of them also involved heroin?

1 A That's correct.

2 Q And just briefly, if we look at your Column
3 C, which is all opioids T40.0, which again that's
4 opium, T40.4, which is fentanyl or other synthetic
5 opioids, am I right that the difference between
6 Column C and Column D in any given year will be
7 overdose deaths that resulted from either heroin or
8 opium, and no prescription opioid; is that correct?

9 A That's correct.

10 Q Okay. So sticking with this exhibit, I
11 just want to review some of the different versions of
12 the calculation you have here.

13 Am I correct in reading this that you
14 listed here five different versions of calculating
15 the number of deaths that resulted from prescription
16 opioids in your opinion?

17 A Wait. I'm sorry, say that again?

18 Q Am I correct that what's disclosed here in
19 Exhibit 6 are five different methodologies for by
20 which you calculated the number of deaths that
21 resulted from prescription opioids?

22 A Five different calculations that I did that
23 provide kind of a range of different possible
24 estimates of deaths attributable to prescription

1 Do you recall that?

2 A Yes.

3 Q Now, as I am sure you recall, I tried
4 asking you some questions about Exhibit 10 at the
5 last deposition, but it wasn't one of the marked
6 exhibits, and there was some confusion about what I
7 was referring to as columns in that file. So I
8 just want to touch on that for a moment.

9 If you look at Exhibit 10, is it possible
10 for you to tell how many deaths there were in Cabell
11 County in 2010 that involved prescription fentanyl
12 and no other synthetic opioid -- I'm sorry, and no
13 other prescription opioid?

14 A I'm just going to fold this over to make it
15 a little bit easier.

16 So Cabell County, year 2010, deaths not
17 including synthetic -- So your question is about
18 deaths that only had T40.4?

19 Q Correct. In the way that you've classified
20 it, I'm asking about Column J, which is the product
21 of when you subtract T40.2 and 3 from the grouping of
22 all of them.

23 MR. ARBITBLIT: Can we just ask --
24 Carl, would you mind restating the question? Because

1 there are a couple of different forms of it. I just
2 want to make sure you have a clear question for the
3 witness to answer.

4 BY MR. METZ:

5 Q Sure. So I won't repeat all the
6 orientation we've just done, but can you tell from
7 Exhibit 10 how many deaths there were in Cabell
8 County that were attributable to prescription
9 fentanyl in 2010 but no other prescription opioid?

10 A Zero.

11 Q How many were there in 2011?

12 A Three.

13 Q And how many were there in 2012?

14 A Zero.

15 Q And combined, those are the last three
16 years for which you had actual counts of the deaths
17 that were coded as resulting from prescription
18 fentanyl, correct?

19 A Can you say what you mean by "actual
20 counts"?

21 Q So after 2012, meaning starting in 2013,
22 you estimated the amount that was the result of
23 prescription fentanyl, correct?

24 A Sorry. Not in Column J. Column J is not

1 And so now having done the calculation,
2 would you agree with me that if the only thing
3 missing between Column G and getting to Column L is
4 the number you haven't reported, but it's your
5 estimate of the prescription fentanyl involved
6 deaths -- those numbers we just calculated --

7 MR. ARBITBLIT: Objection.

8 BY MR. METZ:

9 Q -- 15 in 2018, 18 in 2017, correct?

10 MR. ARBITBLIT: Objection.

11 A Well, I mean, I see what -- I see your
12 reasoning. However, the difference is the --

13 T40.4 deaths were not excluded from Column
14 G, so that would be the contribution of -- that would
15 be this methodology, which is not the methodology I
16 rely on. That would be this methodology's assessment
17 of the contribution of prescription T40.4 deaths.

18 Q Okay. Now, a moment ago we reviewed the
19 last three years for which you had an actual count,
20 or what you regard as an actual count of the
21 prescription fentanyl involved deaths, and it was
22 zero in 2010, three in 2012, and zero in 2012. Do
23 you recall that?

24 A I do.

1 Q Okay. And so just some more very simple
2 math. Three deaths over three years, that's about an
3 average of one per year over that three-year period?

4 MR. ARBITBLIT: Objection.

5 A Yes.

6 Q And so now we have it that in the way that
7 you set about to estimate prescription fentanyl
8 deaths, by 2017 now there is 18 per year, and in 2018
9 there is 15 per year, in your estimation using this
10 calculation that we've talked about, using --

11 A Right, using this calculation, that is what
12 you would conclude.

13 Q And so using this calculation, you would--
14 you would conclude that from 2010 through 2012, then
15 looking ahead to 2017, there would be 18 times more
16 prescription fentanyl deaths than from the years
17 prior, right?

18 MR. ARBITBLIT: Objection.

19 A I didn't draw that conclusion from these
20 data.

21 Q I know you didn't do the analysis, but
22 that's the implication of the data.

23 MR. ARBITBLIT: Objection.

24 A I'm not -- I don't want -- I haven't drawn

1 any implications about percentage increases in
2 prescription fentanyl deaths, so I wouldn't want to
3 offer an opinion on that.

4 Q Not percentage increases. Do you have a
5 basis to disagree with my observation that in the way
6 you have done the calculation that's reflected in
7 Exhibit 10, you claim an estimate that is 18 times
8 larger for the number of prescription fentanyl deaths
9 occurring in 2017 than occurred on average between
10 2010 and 2012?

11 MR. ARBITBLIT: Objection.

12 A I don't quite agree with the premise of the
13 comparison. It's comparing apples and oranges.

14 You're assuming here that -- you're making
15 some assumptions about the contribution of
16 prescription fentanyl before and after 2012.

17 Q Wasn't the entire purpose of the
18 calculation here to try and estimate a number of
19 prescription fentanyl deaths occurring after 2012?
20 And I'm simply telling you what that estimate is
21 based on your calculation and comparing it to the
22 ones you were able to count, right?

23 MR. ARBITBLIT: Objection.

24 A The T40.4 category does not differentiate

1 between prescription fentanyl and nonprescription
2 fentanyl. I agree with you that 18 is a bigger
3 number than 1, on that we can agree. But the
4 allocation to prescription fentanyl pre-2012, I
5 didn't make that comparison.

6 So I agree with you that there is a bigger
7 number attributed to prescription fentanyl after 2012
8 than before 2012.

9 Q I think you have already agreed with pretty
10 much all of this, so let me just lay out a few pieces
11 and you tell me if you disagree with any of it.

12 Prior to 2012, your interpretation of the
13 T40.4 category is that all of those deaths that
14 you're able to count, those are prescription
15 fentanyl, correct?

16 A I'm going to -- I'm going to use pre-2012
17 fentanyl deaths as my estimate of prescription
18 fentanyl deaths.

19 Q Okay. And then because that was confounded
20 by the presence of illicit fentanyl, you devised a
21 methodology for trying to estimate a number of --
22 from within the T40.4 category that you would
23 estimate as prescription fentanyl deaths after 2013?

24 A Yeah, I didn't devise the methodology. I

1 applied the methodology that's standard in my field.

2 Q Okay. And so, for example, we were talking
3 about 2017. You recognize that in Column J there
4 were 100 total T40.4 involved deaths that did not
5 also involve T40.2 or T40.3, correct?

6 A Yes.

7 Q And you were attempting to identify how
8 many of that -- those 100 deaths you could attribute
9 to prescription fentanyl as opposed to illicit
10 fentanyl, correct?

11 A That's right.

12 Q Okay. And following that methodology, the
13 answer you came up with for 2017 was that 18 of those
14 deaths involved prescription fentanyl and the other
15 82 involved illicit fentanyl, correct?

16 A Well, the 18 that involved prescription
17 fentanyl could also involve illicit fentanyl. The
18 remaining, of 100 minus 18, were deaths that did not
19 involve prescription fentanyl.

20 MR. METZ: I have us going about an
21 hour and 12 so far. Why don't we take a short break
22 and reconvene in 10 or 15 minutes?

23 THE DEPONENT: Sure.

24 MR. ARBITBLIT: The shorter the

1 Q And so the proper interpretation of the
2 results that are laid out in sort of a matrix, I
3 think, on the first page of your second errata, the
4 proper interpretation of those, that these figures
5 should supplant or replace the figures that were
6 disclosed in Figure 16 of your first errata?

7 A Yes.

8 Q Okay. And I believe you told me this
9 morning that the calculation underlying this second
10 errata is a calculation you first performed after
11 your September 15th deposition, correct?

12 A That's right.

13 Q Why did you perform this calculation after
14 your deposition?

15 A I reconsidered my approach, and although a
16 ratio like I had done is a standard way of simulating
17 something like this, or estimating this parameter, I
18 decided that a constant number might better reflect
19 the pre-2012 prescription fentanyl.

20 MR. METZ: And I'll just pause and ask
21 if the court reporter heard that okay, because I got
22 a little interference at one point.

23 (The courter reporter responded
24 affirmatively.)

1 Q Okay. So you reconsidered.

2 And so was there something about the
3 results that your ratio method produced that seemed a
4 little off after your deposition?

5 A I thought that after thinking about it
6 more, I thought that the pre-2012 should be a
7 constant rather than a ratio. When you use the ratio
8 method, you have more prescription fentanyl deaths
9 than pre-2012, and I thought a better reflection of
10 the pre-2012 prescription fentanyl deaths might be a
11 constant.

12 Q You had -- For example, in the years 2017,
13 you had 18 deaths, whereas in the last year before
14 you ran an estimation, you had zero deaths, right?

15 MR. ARBITBLIT: Objection.

16 BY MR. METZ:

17 Q Attributable by you to prescription
18 fentanyl and no other prescription opioid, right?

19 MR. ARBITBLIT: Objection.

20 A I mean, that's one year. That's one
21 example. But yes.

22 Q Okay --

23 A -- of the prescription fentanyl
24 contribution would be the pre-2012 constant.

1 Q Okay. And to take another year, in 2018,
2 your prior calculation had estimated that as 15
3 deaths from prescription fentanyl and no other
4 prescription opioids, whereas in the year where you
5 last had actual data, the count was zero, right?

6 MR. ARBITBLIT: Objection.

7 A I mean, in 2013 it was -- it was just more
8 variables across that time. And I thought that a
9 constant might be a more stable reflection of the
10 pre-2012 prescription fentanyl contribution.

11 Q Did you think that a constant would also be
12 a more plausible estimation of the prescription
13 fentanyl overdoses?

14 MR. ARBITBLIT: Objection.

15 A I don't know that I would characterize it
16 that way. I think that I reconsidered my methodology
17 to include a constant rather than a ratio, because I
18 thought it might be a more accurate reflection of the
19 prescription fentanyl contribution.

20 Q Okay. And the constant that you chose to
21 apply, at least as to Cabell County, the constant is
22 plus three, correct?

23 A Yes.

24 Q Okay. And so comparing your earlier ratio

1 method to now your constant method for 2017, your
2 ratio method produced a number six times higher than
3 your constant method does, correct? Sticking within
4 the category of prescription fentanyl deaths?

5 A The ratio method -- It's not exactly -- As
6 you've subtracted out the T40.4 deaths that are
7 prescription opioid attributable, 18 is 6 times
8 higher than 3. I will grant you that. But I didn't
9 make that inference in particular.

10 Q And so in this -- Let's go back to
11 Exhibit 6.

12 A Now that one I didn't write on the top, so
13 which --

14 MR. ARBITBLIT: There is no question
15 pending.

16 MR. METZ: She's just asking for
17 clarification.

18 Exhibit 6 is the Excel printout. So
19 it's another of the broad sheets. But it's a
20 sensitivity analysis, the one that includes multiple
21 different versions of your calculation.

22 MR. ARBITBLIT: Wait for a question.
23 Wait for a question.

24 BY MR. METZ:

1 Q Have you located and now numbered
2 Exhibit 6?

3 A Yes.

4 Q Okay. So this constant calculation that
5 you just referred to a moment ago, that's reflected
6 in Column T through V of Exhibit 6, correct?

7 A Yes.

8 Q All of which were created subsequent to
9 your September 15th deposition, correct?

10 A This calculation was done subsequent to the
11 September 15th deposition.

12 Q Without revealing the substance of any
13 communication with counsel, can you answer yes or no
14 whether you undertook this calculation on your own
15 initiative, as opposed to being instructed to do it?

16 A Yes.

17 MR. ARBITBLIT: I'll instruct -- Yeah.

18 THE DEPONENT: Sorry.

19 MR. ARBITBLIT: Wait for objections.

20 THE DEPONENT: I apologize.

21 MR. ARBITBLIT: Did the court reporter
22 get the answer?

23 MR. METZ: I may have muddied the
24 waters by asking it compound. So why don't I just

1 ask the first part.

2 BY MR. METZ:

3 Q Did you undertake this calculation on your
4 own initiative?

5 A Yes.

6 Q Okay. So in this calculation, to get the
7 results that are contained in your second errata, or
8 at least the first row of your second errata, you
9 take those results from Column T, correct?

10 A The first row of Exhibit 12 corresponds to
11 Column T of Exhibit 6.

12 Q And the way that you get to Column T is you
13 take whatever number is in Column E of Exhibit 6 and
14 you just add the number 3 to it as a formula, right?

15 And I can clarify that I only mean that in
16 reference to the Cabell County portion of --

17 A Oh.

18 Q -- of the spreadsheet.

19 A That's where I was confused.

20 Hold on one second. So Column E and
21 Column T. Yes.

22 Q Okay. When you do the same analysis for
23 West Virginia and the nation, you have different
24 constants that you are applying, correct?

1 A That's right.

2 Q You happen -- Well, we can figure out the
3 math if we need to. But it's a constant number that
4 you're adding for Cabell County, a different constant
5 number you add for West Virginia, and a different
6 constant number you add for the nation as a whole,
7 correct?

8 A That's right.

9 Q And that constant number is based on a
10 calculation you perform of the values contained in
11 Column F, isn't that correct? From 1999 through
12 2012?

13 A That's correct.

14 Q Okay. And in particular, you add up the
15 values that are in your Column F from '99 through
16 2012, and then when you get that total you divide by
17 14, because there are 14 years in that span, correct?

18 A That's right.

19 Q And your number that you come out with is
20 three deaths on average per year that were the result
21 of prescription fentanyl and no other prescription
22 opioid was present?

23 A That's right -- well, my only clarification
24 would be prescription T40.4.

1 Q Prescription T40.4 --

2 A Synthetic opioid.

3 Q Okay. Fair enough.

4 Now, I recognize this methodology and these
5 results did not yet exist when we were at your last
6 deposition, but I was struck by an answer you gave at
7 that deposition where you said that no matter how you
8 estimated the prescription fentanyl, the results were
9 similar every which way you did it.

10 Do you recall that testimony?

11 MR. ARBITBLIT: Objection.

12 Mischaracterizes. You can show her a question and
13 answer from the transcript rather than
14 mischaracterizing it.

15 BY MR. METZ:

16 Q I'm asking whether you recall telling me
17 that it didn't matter which way you calculated the
18 prescription fentanyl share of the T40.4 deaths
19 because your results, quote, "were similar," closed
20 quote, every way you did it?

21 MR. ARBITBLIT: Objection.

22 Mischaracterizes the record.

23 Q Do you recall that testimony?

24 MR. ARBITBLIT: Objection.

1 Mischaracterizes the record.

2 A What I recall saying is of the sensitivity
3 analyses that I performed to estimate the robustness
4 of that share, the sensitivity analyses that I
5 performed yielded similar results.

6 Q Okay. And do you believe that's also true
7 if you now expand that to include this methodology?

8 A When you use the constant, the number of
9 deaths that is directly attributable to prescription
10 opioids decreases.

11 Q Decreases significantly, correct?

12 A I didn't do a statistical test of the
13 change.

14 Q Well, as between the methodology you were
15 relying upon at your September 15th deposition and
16 the one that you rely on since disclosing your second
17 errata, the deaths in Cabell County that you
18 attribute to prescription opioids fell from 32 to 20.
19 Do you see that?

20 A I do.

21 Q That's a decline of nearly 40 percent?

22 A It's 12 deaths. It's a 12-death
23 difference.

24 Q And 12 of 32 is roughly 40 percent?

1 A Sure.

2 Q And for 2017 in Cabell County, your
3 estimate falls from 42 deaths to 27? Do you see
4 that?

5 A I do.

6 Q And that's a decline of roughly 36 percent?

7 A Well, to be fair, the number indirectly
8 attributable to prescription opioid increases. So
9 the absolute change in the number of deaths that are
10 due to prescription opioids is relatively similar.

11 Q I realize you have other ways that you
12 attribute deaths to prescription opioids when they
13 involve heroin and illicit fentanyl, but what I'm
14 really just asking you is the deaths that you're
15 calling directly attributable to prescription
16 opioids, that falls by changing from one to the
17 other, that fell from 42 to 27, right?

18 A Right.

19 MR. ARBITBLIT: Objection.

20 Q And would you regard that as a significant
21 change?

22 A I have not done a statistical test of that
23 change.

24 Q And if we were to make the same comparison

1 against the results that were in your -- originally
2 disclosed with your August 3rd report, so that the
3 results that are in Column K, you agree with me the
4 change is even more stark, right?

5 MR. ARBITBLIT: Objection.

6 A Again, the appropriate way to look at it is
7 the overall change in the number of deaths that's
8 attributable to prescription opioids. And so that
9 would be the comparison that I would make. It would
10 not be just this directly attributable.

11 And also, at no point did I rely on a
12 number in which all of the T40.4 deaths were directly
13 attributable. So the change between that and Column
14 T is not relevant, in my opinion.

15 Q Well, you may not have thought you were
16 relying upon it, but that was the number included
17 within the expert report you signed, correct?

18 MR. ARBITBLIT: Objection.

19 A I believe that's why an errata was issued.
20 I didn't rely on -- It was a typo.

21 Q You didn't rely on it at any point? Do you
22 know whether other experts relied on that at some
23 point?

24 MR. ARBITBLIT: Objection,

1 Speculative.

2 A I'm not aware of what other experts are
3 relying on.

4 Q Now, I think we've sufficiently established
5 that the -- that your -- with this second errata, you
6 now calculate a lower number of deaths that are
7 directly, in your vernacular, attributable to
8 prescription opioids, correct?

9 A Yes.

10 Q And that means by implication that if you
11 were today to sit down and reconstruct your Figure 8,
12 the Figure 8 that is disclosed in your report would
13 be wrong, correct?

14 A I would have updated estimates in Figure 8.

15 Q And you have not at any point issued an
16 errata updating your Figure 8, correct?

17 A The numbers in Figure 8, I think, are
18 included in the second errata. But I have not
19 produced a new Figure 8 that has been supplied.

20 Q Well, you understand that your Figure 8 is
21 presented as a rate of death per 100,000 people,
22 correct?

23 You are welcome to look at it. It's in
24 your report.

1 A Yes. That's what's written in the report.

2 Q The purpose of the analysis is to
3 illustrate differential rates of overdose deaths from
4 prescription opioids in Cabell County, West Virginia,
5 and the United States as a whole, correct?

6 A Yes.

7 Q And as we discussed this morning, to get
8 there requires some additional calculations beyond
9 simply calculating a number of prescription opioid
10 deaths. You then -- you had a further division, and
11 this was all presented in -- I believe, it's Column Q
12 of Exhibit 10, right?

13 A Right.

14 Q Okay. And that's the information that is
15 ultimately plotted in your Figure 8, right?

16 A Yes.

17 Q Okay. Is the information that's -- that
18 would be more accurately plotted in Figure 8 today,
19 are those numbers stated in your second errata?

20 A No.

21 Q Now, would you return to Tab 10, please --
22 excuse me, Exhibit 10. It says "tab"...(fading).

23 A Okay.

24 Q Do you have that in front of you?

1 A I do.

2 Q As we talked about, this was the version of
3 your calculation that essentially existed as of your
4 first deposition, the calculation that supports the
5 figures in your first errata. I'm not trying to go
6 back over that. I'm just trying to make sure we're
7 properly oriented.

8 Do you see in Column S there is a notation
9 that states that for 2009, deaths have been set to 5,
10 as this is the mid point in the range of possible
11 suppression values. Do you see that?

12 A I do.

13 Q And what does that mean?

14 A In the CDC WONDER data, numbers below five
15 are suppressed. They're not provided, because it
16 could be identifiable. So sometimes when a number is
17 below five, we don't know what the number is -- I'm
18 sorry, when the number is below ten it's suppressed.

19 Q When the number is below ten?

20 A Yes.

21 Q And so if we -- just to see an example of
22 this, if you were to look at Column D for the year
23 2009, which is what your note references, you have an
24 "NA" listed there. What does the NA represent to

1 you?

2 A I believe that is values that were
3 suppressed.

4 Q "NA" means not available or something along
5 those lines?

6 A Right.

7 Q And so -- And so even though you don't have
8 a value for 2009 Cabell County, Column D, which is
9 the total deaths involving T40.2, T40.3 or T40.4, and
10 even though you don't have a value for Column G in
11 2009, which is the share that excludes -- that is
12 only T40.2 and T40.3, and even though you don't have
13 a value in Column J, which is the residual that's
14 T40.4 that doesn't involve the other two, despite
15 that, you include under Column A five deaths
16 attributable to prescription opioids, right?

17 A It's not that we don't have a value, we
18 just know that the value is between zero and nine.
19 So a reasonable approximation is to use the midpoint.

20 Q Sure. I'm not quibbling right now with the
21 reasonableness of what you did. I'm just trying to
22 understand it. So you say it's not that you don't
23 have a value, it's just that you don't know if the
24 value is between zero and nine. That means the value

1 could be zero?

2 A And it could be nine.

3 Q Was that a "yes" that it could be zero?

4 MR. ARBITBLIT: Objection.

5 BY MR. METZ:

6 Q In my outline, I'm going to ask you nine as
7 well. So you don't have to answer that way.

8 Is it correct that the value for that year
9 for the totality of overdose deaths could have been
10 zero?

11 A We don't know what the value is.

12 Q I understand that --

13 A I don't want to speculate on what it could
14 have been. We know that it is between zero and nine,
15 which I think is inclusive of all numbers between
16 zero and nine.

17 Q Okay. For the record, I'm not asking you
18 to speculate. I'm simply asking you to answer a
19 pretty straightforward question, which is: Is it
20 possible that that number is zero?

21 MR. ARBITBLIT: Objection.

22 BY MR. METZ:

23 Q Is that a yes?

24 A It's equally possible that the numbers are

1 between zero and nine. So I would just be inclusive
2 of all the possibilities.

3 Q Okay. Let me ask it this way. It's
4 possible the number is nine, yes?

5 A I would have the same answer. I don't want
6 to speculate on what the possible number is. All
7 numbers between zero and nine are possible, which
8 would be inclusive of zero and nine.

9 Q Okay. I think I have my answer.

10 And so now, just to understand your
11 methodology, so then when you went to calculate the
12 number to the total number of deaths that were
13 directly the result of prescription opioids, you
14 thought it reasonable, so you picked that midpoint of
15 five and you plugged that in as the number for 2009,
16 believing that numbers on either side of it were
17 equally as likely, correct?

18 A That's right.

19 Q Now, in your report, and in your -- both
20 your first and second erratas, you disclosed a number
21 of deaths directly as a result of prescription
22 opioids only for the years 2006 forward. Do you
23 agree with that?

24 A Can you repeat the question?

1 Q Sure. In your report and in each of your
2 two errata, wherever you are disclosing the number of
3 deaths that you attribute directly to prescription
4 opioids, the first year of which you do that is 2006,
5 correct?

6 A In the errata, yes.

7 Q And also in your report, correct?

8 So, for example, your Figure 16 only goes
9 back to 2006, correct?

10 A Figure 8 goes back to 1999; 16, goes to
11 2006.

12 Q Okay. Thank you for that correction. You
13 are correct about how far back Figure 8 goes.

14 Is the reason that your Figure 16 does not
15 go back earlier than 2006, that starting with 2005
16 and earlier, you run into this data suppression issue
17 more frequently?

18 MR. ARBITBLIT: Objection.

19 A No. That's not the reason that I only went
20 back to 2006 for that estimation.

21 Q Okay. Do you agree that with the
22 observation that from 2005 and earlier, you run into
23 the data suppression issue that you described more
24 frequently than you do thereafter, at least as it

1 relates to Cabell County?

2 A As it relates to Cabell County, there are
3 two years in which the T40.2, -3, and -4 deaths are
4 suppressed out of -- one, two, three, four, five --
5 wait. I'm sorry. You said before 2006?

6 Q From prior to 2006, yes. So starting in
7 2005, do you agree with me that the data suppression
8 problem, if you will, or complication, occurs more
9 often in those years?

10 A So there is data suppression in three of
11 those seven years. And then after 2006, there is
12 data suppression in one year. So there is two
13 additional years of data suppression. I don't think
14 that's -- three is greater than one as a number, but
15 it wouldn't have a meaningful difference.

16 Q Well, for purposes of your answer, are you
17 only looking at Column G right now?

18 A Yes.

19 Q Okay. I would like you to take a look
20 at -- I would like you to take a look at Column G and
21 tell me if you have the same answer.

22 A So in Column G, this is prescription
23 opioids T40.2 and T40.3. There is two years with
24 data prior to 2006, and all the years except one have

1 data after 2006.

2 Q And so just to be clear, that's -- there
3 are five years for which the data is suppressed in
4 that column, and only one year when it's not
5 suppressed by 2006, correct?

6 A That's right.

7 Q Okay. And we don't have to visually go
8 over it, but in each of those cells that you just
9 looked at, you have a visual representation of "NA,"
10 not available, right?

11 A That's right.

12 Q And then I asked you to do the same for
13 Column J, which represents after you subtracted out
14 the T40.2 and T40.3, leaving only deaths that
15 involved a synthetic opioid and no other prescription
16 opioid present, you agree with me again, the data is
17 suppressed in five out of the six years?

18 A Yes.

19 Q And so you have an "NA" in those
20 categories, right?

21 A I do.

22 Q Okay. And for purposes of the calculation
23 that is disclosed in your first errata, would you
24 agree with me, the unavailability of that data has no

1 real impact on Figure 16, because Figure 16 only goes
2 back to 2006 anyway?

3 MR. ARBITBLIT: Objection.

4 A I don't quite understand the premise of the
5 question. Figure 16 starts at 2006. After 2006 in
6 Column J there is one year of data suppression. And
7 so prior years of data suppression would not be
8 relevant.

9 Q That was the answer I thought I would get.

10 Now, looking at this exhibit, this
11 Exhibit 10, if we take in the period 1999 to 2012, if
12 we take only those years for which Column J is not
13 suppressed and we try to add that up, would you agree
14 with me you have only the following entries that are
15 actual numbers and not NA in Column J? You have the
16 number three in 2002?

17 Do you see that?

18 A I do.

19 Q Okay. You have the number four in 2004?

20 Do you see that?

21 A I do.

22 Q You have the number four in 2006, do you
23 see that?

24 A Uh-huh.

1 Q You have the number five in 2007?

2 A Yes.

3 Q You have the number six in 2008?

4 A Okay.

5 Q You have the number zero in 2010, do you
6 see that?

7 A Yes.

8 Q And that's not a data suppression issue,
9 that, you actually know it to be zero, yes?

10 A That's right.

11 Q You have the number three in 2011?

12 A Yes.

13 Q And you have a zero again in 2012, correct?

14 A Yes.

15 Q And again, that zero is not a data
16 suppression issue, you have the data, and you know
17 the number to be zero?

18 A Yes.

19 Q Okay. And so the record is clear to anyone
20 who hasn't read this full deposition, those numbers
21 we just counted up, those are the actual counts
22 available to you of deaths that were contributed to
23 in your analysis by prescription fentanyl and no
24 other prescription opioid was present, correct?

1 A That's right.

2 Q Okay. Now --

3 A Wait. I'm sorry. Can you say that again?

4 Q Yes. Those --

5 A This has T40.4 as a contributing opioid
6 without T40.2 or T40.3.

7 Q Correct. And as we talked about this
8 morning, there are sort of lay descriptions that may
9 be more relatable, and T40.4 is synthetic opioids
10 that generally consist of fentanyl and fentanyl
11 analogs, correct?

12 A Yes.

13 Q Okay. And during this period prior to and
14 up through 2012, your interpretation is, those
15 numbers, whenever you have a number there, that means
16 prescription fentanyl was prior to the arrival of
17 illicit fentanyl?

18 A Yes.

19 Q Now, just a couple quick observations about
20 those numbers. Would you agree with me that the
21 highest year for which you have an actual count of
22 the prescription fentanyl involved deaths that didn't
23 include other prescription opioids, the highest
24 number in that grouping was six?

1 A Prior to 2012?

2 Q Yes.

3 A The highest number is six.

4 Q Okay. And the reason I say prior to 2012,
5 is after 2012, you're not counting that directly for
6 the reasons we discussed at length, yes?

7 I need a verbal yes or no.

8 A Yes.

9 Q Okay. And so there were no years where
10 there were seven or more overdose deaths in this
11 category?

12 A For Column J in this exhibit, there is not
13 a number that is greater than six between 1999 and
14 2012.

15 Q Okay. And if I add up all the years for
16 which there are numbers in Column J during that time
17 period, I get to 25 total overdose deaths involving
18 fentanyl and no other prescription opioid.

19 Do you agree with that count?

20 A I would just say it's synthetic opioids and
21 not fentanyl.

22 Q Okay. If I change it to synthetic opioids,
23 would you agree or disagree with my count of 25?

24 A Let me just do some quick math.

1 Yes.

2 Q And as you mentioned, it doesn't mean that
3 there weren't overdose deaths in other years, that
4 data was suppressed, and it's anywhere between zero
5 and nine in those other years, correct?

6 A Yes.

7 Q And at least for purposes of the
8 calculations you had performed prior to your
9 deposition, the only year for which you replaced
10 suppressed numbers with the number five was for 2009;
11 isn't that correct?

12 A I would need to go back and look in more
13 detail in my files to know exactly which cells got
14 replaced.

15 Q Well, you do see, as you mentioned, the
16 number of entries that are "NA," or not available,
17 yes?

18 A I do.

19 Q And you -- We correctly interpret those as
20 data suppression references, right?

21 A Yes.

22 Q Okay. And do you see the notation that
23 appears in Column S, Row 2, that says for 2009, the
24 correct data were replaced with the ...(trailing) --

1 (Court reporter requested clarification.)

2 I'll ask it again. You do see the notation
3 under Column S that says for 2009, deaths have been
4 set to five, as this is the mid point in the range of
5 possible suppression values? You see that notation,
6 right?

7 A Yes.

8 Q And do you understand that to mean that at
9 least as of that calculation that you were relying on
10 at your last deposition, 2009 is -- was the only year
11 for which you had replaced and suppressed a number
12 with the number five?

13 A I would need to go back and look for sure
14 to know that that was the only year in which five was
15 used instead of "NA." I agree that five was used as
16 the mid point for 2009.

17 Q Okay. As you sit here, do you have any
18 reason to believe that despite what that note says,
19 that for purposes of this calculation, you replaced
20 any other suppressed data with the number five?

21 A I would need to go back and look.

22 Q Okay. You don't have a belief one way or
23 the other?

24 A Right.

1 Q All right. Now would you turn back to
2 Exhibit 6. And I may ask you to make some
3 comparisons here, so if you keep Exhibit 10 within
4 reach, that may be helpful.

5 A Okay.

6 Q Do you see on Exhibit 6 a notation that
7 says: "Suppressed values were set to five," it's in
8 the cell in Row 1, Column A?

9 A Yes.

10 Q And is that a notation that you made
11 subsequent to your first deposition?

12 A These were collected from various other
13 documents, so I don't know when exactly that cell was
14 written.

15 Q Do you know whether you wrote that cell?

16 A It was either me or my data analyst who
17 helped me prepared this.

18 Q Do you know whether cells that formerly had
19 "NA" due to data suppression were changed to the
20 number five in the preparation of this Exhibit 6?

21 A For this sensitivity analysis, you can see
22 in Column D that we set the suppression values to
23 five.

24 Q And do you know whether that was done

1 before or after your deposition on September 15th?

2 A Before.

3 Q Do you know that for a fact?

4 A Yes.

5 Q Okay. Was it done before or after the
6 preparation of your original expert report on
7 August 3rd?

8 A That, I'm not sure. Before, in all
9 likelihood, because we did all of these analyses in
10 preparation for that report.

11 Q Okay. Now, it says here that suppressed
12 entries were set to five. I just want to make sure I
13 understand correctly. That means on its face it
14 suggests that where you have data suppression,
15 instead of "NA," you now have the number five for
16 purposes of your calculation, right?

17 A That's right.

18 Q Okay. However, despite that, am I right
19 that you did not replace all of the suppressed
20 entries from Exhibit 10 with the number five?

21 A In Exhibit 10 not all of the entries were
22 suppressed with five.

23 Q I'm sorry. That's not what I meant.

24 In Exhibit 6, not all of the entries that

1 previously had been suppressed in Exhibit 10 were set
2 to the number five; isn't that correct?

3 A Exhibit 6. Can you give me an example?
4 I'm not sure I understand the question.

5 Q Sure. Let me start by giving you some
6 examples of ones that were switched from suppressed
7 to the number five. So would you agree with me,
8 Dr. Keyes, that the cells in Column D, Row 43, of
9 Exhibit 10 corresponds to the cell that is Row 4,
10 Column D, of Exhibit 6?

11 A I'm sorry. So it's Exhibit -- okay. I'm
12 getting confused here.

13 Q I'm not trying to confuse you. I do want
14 to make this clear.

15 A Exhibit 10. So I'm looking at Exhibit 10,
16 and I'm going to Column D, Row 43.

17 Q Right. And you see there is an "NA,"
18 indicating that the data was suppressed for that
19 cell?

20 A Yes. I see that.

21 Q Okay. And then on Exhibit 6, do you agree
22 with me that Column D, Row 4, corresponds to the same
23 circumstance, if you will, 1999, Cabell County,
24 prescription opioid deaths inclusive of all three of

1 those categories, and now the value is set to five?

2 A Right. That's true.

3 Q Okay. So those are equivalent cells in the
4 workbook, the one that existed as of your deposition
5 listed as "not available," and in Exhibit 6 it's
6 listed as "five," right?

7 A That's right.

8 Q Okay. And if you just look at the cell
9 immediately below that, which is the year 2000 for
10 Cabell County, and you make the same comparison, you
11 agree there as well that suppressed data has been
12 replaced with the number five, right?

13 A Yes.

14 Q Okay. And if we move over -- on Exhibit 6,
15 if you move over one cell, so now we're in Column
16 D -- I'm sorry, now we're in Column E, would you
17 agree with me that Row 4, Column D, of Exhibit 6
18 corresponds to Row 43, Column G of Exhibit 10? That
19 those are meant to capture the same circumstance?

20 A That's right.

21 Q Okay. And that in Column G -- I'm sorry,
22 excuse me, in Exhibit 10, that all shows up as the
23 data suppressed, "not available," and in Exhibit 6 it
24 shows up as the number five?

1 A That's right.

2 Q Okay. So those are some examples of cells
3 that in the one analysis were listed as the data
4 suppressed and it just remained at "NA," and then in
5 this analysis, in figure -- in Exhibit 6, they've
6 been replaced with the number five?

7 A Right.

8 Q Are you aware of whether or not there are
9 other cells that in Exhibit 10 show up as "NA"
10 because the data was suppressed, and in Exhibit 6
11 have a value different from five?

12 A Yes. I can see other cells.

13 Q And those are the cells in Column F,
14 correct? Of Exhibit 6?

15 A Column F is the estimate of the number of
16 synthetic opioid-only deaths, and in Exhibit 6, there
17 are values for every year, and I believe it
18 corresponds to Column J of Exhibit 10, in which some
19 years have "NA" and some years have numbers.

20 Q Okay. And isn't that because Column F of
21 your -- of Exhibit 6 is -- is the product of a
22 subtraction. You take the value that is in Column D,
23 and you subtract from it the value that is in Column
24 E, or whatever is left over as the residual, that is

1 what goes into Column F?

2 A Yes.

3 Q And so just taking an easy example, in 1999
4 where Column D and Column E were both populated with
5 the number five, they cancel each other out, and the
6 value in Column F is zero, right?

7 A That's right.

8 Q Okay. And so you did not systematically
9 populate the information that was suppressed in
10 Column J, you didn't systematically populate that as
11 the number five in Exhibit 6; instead, you just
12 derived a number based on the other suppressed
13 values, right?

14 A I don't understand the question.

15 Is the question: How is Column F
16 calculated?

17 Q Sure. That's a better version of the
18 question.

19 A Column F in Exhibit 6 is calculated as the
20 number of estimated deaths of prescription opioids
21 not including synthetics, minus the number that does
22 include synthetics, and when those are both
23 suppressed, that number is zero.

24 Q So let's look at the year 2001, Cabell

1 County. Starting with Row C.

2 A Column C?

3 Q I'm sorry. And I don't even mean that. I
4 mean Column D. So starting with Column D, you have
5 there an actual count of the total overdose deaths
6 that were coded either T40.2, T40.3 or T40.4,
7 correct?

8 A Yes.

9 Q And you're welcome at any time to
10 cross-reference Exhibit 10 if you need it in order to
11 answer this question. But after having that total
12 death number, because it's larger than the number
13 nine, the next two columns were both suppressed in
14 the CDC WONDER data because their totals were
15 somewhere between zero and nine, right?

16 A The next, Column E, is the only suppressed
17 value, and that's the prescription opioids not
18 including synthetic. So that's the number just of
19 T40.2 and T40.3.

20 Q Okay. And then if we look at 2003 -- well,
21 wait a minute. I'm not going to -- I'm not going
22 to -- Let me not move on quite so quick.

23 I think you said the number in Column E for
24 2001 is the only one suppressed. But if you look

1 back at Column J for 2001, does that number not also
2 show up as suppressed?

3 A Well, that's a bit of a misnomer, because
4 that's a calculated value. So we don't get that
5 value directly from CDC WONDER.

6 Q You could have?

7 A We can't -- we can't get that value.
8 That's why we calculated it.

9 Q You couldn't query just T40.4 in 2001?

10 A No, you can't do that in CDC WONDER. You
11 can't get the values for a single mutually exclusive
12 category. So if we queried it from CDC WONDER, we
13 would get T40.4 and it might include other things.

14 Q Okay. Fair enough. So I understand. It's
15 not technically correct to say that number is
16 suppressed. However, you don't know the actual value
17 of that number, correct?

18 A That's right.

19 Q And that's because the number that is in
20 Column E of Exhibit 6, that number was suppressed,
21 and so you're unable to derive what number should go
22 in Column F, right?

23 A You mean J? We're unable to derive what
24 number to go in J.

1 Q Sorry. Yeah. Column J of Exhibit 10?

2 MR. ARBITBLIT: Objection.

3 A Yes.

4 Q That's correct. Okay.

5 But for purposes of your calculation that
6 now is reflected in your second errata, you have
7 derived from Exhibit 6 a number corresponding to the
8 synthetic opioids only without the presence of T40.2
9 or T40.3. Do you see that? That result is reflected
10 in Column F, Row 6?

11 A That's right.

12 Q And you have listed there that there are
13 seven for 2001 Cabell County -- seven overdose deaths
14 resulting from synthetic opioids without the presence
15 of other prescription opioids, correct?

16 A That's correct.

17 Q And as we talked about a few minutes ago,
18 that number seven would be higher than any year for
19 which you had actual numbers that you could
20 calculate, right?

21 A That number is higher than Column J, 1999
22 to 2006, I think is what we were talking about, for
23 2008.

24 Q And just so the record is clear. Column J

1 of Exhibit 10 is meant to reflect the same category
2 of information as Column F of Exhibit 6, yes?

3 A Yes.

4 Q And in Exhibit 10, this entry for 2001
5 shows up only as "NA" here in Column J of Exhibit 10,
6 but here in Exhibit 6, you've derived that number to
7 be the number seven, right?

8 A That's right.

9 Q And that's because in Column E you plugged
10 in the assumed value of five for that data that was
11 suppressed, right?

12 A Yes.

13 Q Now, if we look at -- And so you would
14 agree with me, right, that despite showing up as the
15 number seven in Column F of Exhibit 6 for 2001,
16 that's really just an assumption you're making that
17 there were seven overdose deaths that year involving
18 synthetic fentanyl -- excuse me, synthetic opioids
19 and there were no other opioids present, right?

20 MR. ARBITBLIT: Objection.

21 A We don't call that an assumption in
22 epidemiology. We call it an estimate. I estimate
23 that there were seven deaths.

24 Q You estimate that there were seven deaths

1 by just picking a midpoint number for a different
2 column of information and then subtracting that from
3 known information leading to the number seven,
4 correct?

5 A That's the standard way of estimating that
6 parameter in my field. So, yes, that's what I did.

7 Q Well, I'm still a little confused, because
8 that number is higher than any individual year where
9 you were able to count it. So is it standard in
10 epidemiology to use a method of estimation that leads
11 you to, in the years for which you're missing data,
12 higher estimates than any real-world examples?

13 MR. ARBITBLIT: Objection.

14 A That is -- that happens sometimes when
15 you're estimating parameters. And the highest value
16 in prior years is six. This is a seven. That's
17 pretty well within the ballpark.

18 Q Okay. And now if you look at 2003, do you
19 agree with me by looking at Column D, this is another
20 year for which the total number of overdoses is not
21 suppressed. You have that number. It's 15.
22 Correct?

23 A Yes.

24 Q However, the number that were -- that

1 involved either T40.2 or T40.3, other prescription
2 opioids, that number was suppressed, right?

3 A That's right.

4 Q And because it was suppressed, you picked
5 the number five to go in that cell?

6 A Yes.

7 Q Correct? And as a result, for 2003 you're
8 estimating there would be ten --

9 A That's right.

10 Q -- synthetic prescription fentanyl overdose
11 deaths without other prescription opioids present,
12 correct?

13 A Yes.

14 Q And ten -- I don't know if you call it in
15 the same ballpark as six or not, but ten is bigger
16 than six, right?

17 A I would call that in the same ballpark.

18 Q Okay. And there was only one real world
19 year where the count was six, right?

20 MR. ARBITBLIT: Objection.

21 A They're all real years.

22 Q Well, they're all real years, but for some
23 of those years, you don't know the number, so you're
24 estimating?

1 MR. ARBITBLIT: Objection.

2 A I would say that there were years in which
3 both numbers were from the CDC WONDER data and some
4 years where one number was directly from the CDC
5 WONDER data. And for the years in which both numbers
6 were derived directly from CDC WONDER, the largest
7 number was six and the smallest number was, I
8 believe, three.

9 Q --

10 A So as -- sorry.

11 Q Isn't the smallest number actually zero?

12 A From Exhibit 10?

13 Q Yes.

14 A I thought we were talking about 2006 and
15 prior. No?

16 Q I'm not at the moment.

17 Isn't the smallest number for which you
18 have actual real world counts zero? The number that
19 you get to at least twice?

20 A For which years?

21 Q For Column J, 2010 and 2012.

22 A Yes, 2010 and 2012, the estimate is zero.

23 Q Okay. And so for these two example years
24 we just looked at, 2001 and 2003, the method you

1 picked to estimate, by virtue of just sticking the
2 number five into Column E, you come up with two
3 estimates for Column F that are both larger than any
4 single year between 1999 and 2012 where you had
5 actual data, right?

6 A And there are other years where the
7 estimate is zero. Sometimes it's higher, then
8 sometimes it's smaller than the average. That's kind
9 of how math works.

10 Q And so as you talked about before, if you
11 had stuck to calculating the average based on those
12 years for which you can actually count a number of
13 deaths in the -- from the CDC WONDER database, you
14 would have had 25 deaths that you could count over 14
15 years, correct?

16 MR. ARBITBLIT: Objection.

17 BY MR. METZ:

18 Q That's what's reflected in --

19 A No.

20 Q That's what's reflected in Column J of
21 Exhibit 10, right?

22 MR. ARBITBLIT: Objection.

23 A No. That's not right.

24 Q Are you able to count up more than 25

1 A No, I'm honestly confused about the
2 question.

3 Q That's fine. Are you looking at Exhibit 6
4 or Exhibit 10?

5 A I'm looking at Exhibit 6.

6 Q Okay. In Exhibit 6, do you agree with me
7 that in Cell 17, which is the synthetic-opioid-only
8 overdoses for 2012 for Cabell County, the value is
9 zero?

10 A Yes.

11 Q And do you also agree with me that two
12 years prior to that, the value was also zero in 2010?

13 A Yes.

14 Q And we talked about this before, but just
15 so I have it all in one place in the record. Those
16 were not data suppression issues, those were you had
17 the data available, and that's how the count came
18 out, correct?

19 A That's correct.

20 Q And so in two of the last three years for
21 which you had actual data available, you -- there
22 were zero deaths in this category of synthetic
23 opioids, not including any other prescription opioid,
24 right?

1 A Yes. In the other year it was three, which
2 is the average of all years. Some years it's going
3 to be lower, some years it's going to be higher.
4 That's why you use the average.

5 Q Well, just to be clear, it's the average of
6 all years when you add in the 17 combined that you
7 include for 2001 and 2003, right?

8 A It's also the average if you use the eight
9 years for which you had data, which there were data
10 available. It wasn't suppressed.

11 Q And despite two of the three most recent
12 actual years being zero, you -- under the method
13 you're now using, you add three additional
14 prescription fentanyl deaths for 2013 by assumption,
15 correct?

16 A I disagree with the premise of the
17 question. I added three additional prescription
18 fentanyl deaths, not despite there being two years in
19 which it wasn't three, but because the average for
20 all years was three.

21 Q I might need to go back over what we just
22 went over, to explain how you got to that average.

23 But you're adding three in 2013
24 notwithstanding that in 2012 and in another recent

1 year before 2012, the number was zero, right?

2 MR. ARBITBLIT: Objection.

3 A I'm adding three because that was the
4 average for all years.

5 Q And for 2014, you add three more deaths in
6 those categories of prescription opioids overdoses
7 that are attributable to synthetic opioids and not
8 other prescription opioids, right?

9 A 2014, I add three deaths attributable to
10 prescription opioids that did not have a code of
11 T40.2 or T40.3.

12 Q And you did the same thing for 2015. You
13 added three more there by assumption, correct?

14 A That's right.

15 Q And then you did the same thing for 2016,
16 you added three more deaths in there by assumption as
17 well, correct?

18 MR. ARBITBLIT: Objection. Objection.

19 A Yes.

20 Q And then for 2017 you added three more
21 deaths by assumption as well, correct?

22 A I'm sorry, it's not by assumption. It's
23 because that's the method that I use to estimate
24 the -- it's not an assumption, it's an estimate.

1 Q And you added three more through that
2 method for 2017, correct? Three more overdose deaths
3 in this category?

4 A That's right.

5 Q And you added three more for 2018 in this
6 category as well, correct?

7 A Yes.

8 Q Did you allow in your methodology for there
9 to be any years similar to the two out of three
10 immediately preceding years in which there were no
11 deaths in this category? Did you allow for any years
12 to be like them?

13 A That would not be a methodology that I
14 would find reliable. So, no, I did not.

15 Q Now, can you direct me -- Using Exhibit 1
16 which is your report, can you direct me to where it
17 is in your report that you describe the reasons and
18 basis for this average deaths carried forward
19 methodology that we've just been discussing. Where
20 in your report can I find that described?

21 A It was not in the August 3rd report.

22 Q It's not located in that report anywhere,
23 correct?

24 A That's right.

1 Q Where in your first errata can I find a
2 description of the reasons and basis for that
3 methodology?

4 A It was also not in the first errata.

5 Q Where in your second errata served after
6 your deposition can I find a discussion of the
7 reasons and basis for that methodology?

8 MR. ARBITBLIT: Objection.

9 A The numbers are provided in the second
10 errata, but a narrative description is not provided.

11 Q And so it's fair to say in terms of any
12 written disclosures to the Defendants, you've not
13 provided anywhere a discussion of this methodology or
14 the reasons and basis for it, correct?

15 A I have -- Sorry. I have provided updated
16 numbers and a data file, and that's all I have
17 provided thus far.

18 Q Just the results, right?

19 A The results.

20 Q And how about your methodology for
21 replacing suppressed data in some columns with the
22 number five, where in your report can I find an
23 explanation of your reasons and basis for making that
24 adjustment when the data is suppressed?

1 A I don't think it's described in the report.

2 Q Is it described anywhere in your first
3 errata?

4 A I don't believe so.

5 Q Is it described anywhere in your second
6 errata?

7 A No.

8 Q Are you aware whether epidemiologists in
9 your field have developed advanced statistical
10 techniques for estimating the values of data that
11 have been suppressed from the CDC WONDER database?

12 A There are various techniques that people
13 use for data imputation, and replacing it with a mean
14 value is a very commonly used method.

15 Q Can you cite a paper in which that's
16 described as an accepted methodology to plug in the
17 number five?

18 A Sure. There's many examples of that used
19 in the epidemiological literature. Off the top of my
20 head, I don't have a citation available, but it's
21 incredibly commonly used.

22 Q Okay. Not just off the top of your head,
23 but if I asked you to, you know, look at your report
24 and look at your errata and the various written



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EXHIBIT
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	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
			Rx opioids including synthetic: T40.2, T40.3, T40.4			Rx opioids not including synthetic: T40.2, T40.3						All opioids: T40.1, T40.2, T40.3, T40.4*						
				Age	Age		Age		T40.2-T40.4 minus T40.2 and T40.3 (Deaths that had only T40.4 as a contributing Rx opioid)	% of T40.2-T40.4 deaths that only have T40.4 as contributing Rx opioid	Estimated number of Rx opioid overdose deaths	All deaths due to opioids	Deaths due directly to Rx opioids	Deaths due to non-Rx opioids	Deaths due attributable to Rx opioids	Estimated crude rate of Rx opioid overdose death		*for 2009, deaths have been set to 5, as this is the midpoint in the range of possible suppression values
2	Year	County	Population	Deaths	Crude Rate	Adjusted Rate	Deaths	Crude Rate	Adjusted Rate									
3	1999	National	279040168	4030	1.444	1.446	3442	1.234	1.219	588	0.145905707	4030				1.444		
4	2000	National	281421906	4400	1.563	1.542	3785	1.345	1.33	615	0.139772227	4400				1.563		
5	2001	National	284968955	5528	1.94	1.922	4770	1.674	1.664	758	0.137120116	5528				1.94		
6	2002	National	287625109	7456	2.592	2.59	6483	2.254	2.253	973	0.130488927	7456				2.592		
7	2003	National	290107933	8517	2.936	2.926	7461	2.572	2.567	1056	0.123987319	8517				2.936		
8	2004	National	292805298	9857	3.366	3.367	8577	2.929	2.931	1280	0.129856954	9857				3.366		
9	2005	National	295516599	10928	3.698	3.679	9612	3.253	3.246	1316	0.120424597	10928				3.698		
10	2006	National	298379912	13723	4.599	4.58	11589	3.884	3.855	2134	0.155505356	13723				4.599		
11	2007	National	301231207	14408	4.783	4.76	12796	4.248	4.239	1612	0.11882288	14408				4.783		
12	2008	National	304093966	14800	4.867	4.842	13149	4.374	4.3	1651	0.111554054	14800				4.867		
13	2009	National	306771529	15597	5.084	5.036	13523	4.408	4.352	2074	0.13297429	15597				5.084		
14	2010	National	308745538	16651	5.393	5.361	14583	4.723	4.702	2068	0.124196745	16651				5.393		
15	2011	National	311591917	16917	5.429	5.416	15140	4.859	4.863	1777	0.105042265	16917				5.429		
16	2012	National	313914040	16607	5.099	5.064	14240	4.536	4.493	1767	0.110389205	16607				5.099		
17	2013	National	316128839	16235	5.136	5.089	14145	4.474	4.418	2090		14411				4.559		
18	2014	National	318657056	15893	5.305	5.305	14638	4.653	4.59	4055		15353				4.815		
19	2015	National	321418820	12558	7.021	7.038	15281	4.754	4.77	7317		16211				5.044		
20	2016	National	323127513	13445	10.041	10.171	17087	5.288	5.246	15358		19039				5.892		
21	2017	National	325719178	40051	12.296	12.49	17029	5.228	5.179	23022		19955				6.126		
22	2018	National	327167434	40893	12.499	12.726	14975	4.577	4.507	25918		18269				5.584		
23	1999	West Virginia	1811799	27	1.49	1.492	15	NA	NA	12	0.444444444	27				1.49		
24	2000	West Virginia	1808344	37	2.046	2.09	30	1.659	1.695	7	0.189189189	37				2.046		
25	2001	West Virginia	1801481	131	7.272	7.445	104	5.773	5.977	27	0.20610687	131				7.272		
26	2002	West Virginia	1805414	169	9.361	9.562	144	7.976	8.162	25	0.147926994	169				9.361		
27	2003	West Virginia	1812295	191	10.539	11.133	165	9.104	9.655	26	0.136125654	191				10.539		
28	2004	West Virginia	1816438	240	13.213	13.622	194	10.68	11.073	46	0.191666667	240				13.213		
29	2005	West Virginia	1820492	137	7.525	7.995	107	5.878	6.215	30	0.218978102	137				7.525		
30	2006	West Virginia	1827912	275	15.044	15.562	242	13.239	13.669	33	0.12	275				15.044		
31	2007	West Virginia	1834652	317	17.284	18.161	257	14.013	14.709	60	0.189274448	317				17.284		
32	2008	West Virginia	1840310	342	18.584	19.327	288	15.45	16.295	54	0.157894737	342				18.584		
33	2009	West Virginia	1847775	158	8.551	8.855	133	7.198	7.451	25	0.158227848	158				8.551		
34	2010	West Virginia	1852994	431	23.26	24.427	378	20.399	21.468	53	0.122969838	431				23.26		
35	2011	West Virginia	1853364	524	28.242	29.993	476	25.655	27.3	48	0.091603053	524				28.242		
36	2012	West Virginia	1855413	431	23.229	24.815	390	21.02	22.479	41	0.09512761	431				23.229		
37	2013	West Virginia	1854904	414	22.326	23.414	368	19.846	20.846	46		376				20.777		
38	2014	West Virginia	1850336	437	23.617	24.663	383	20.699	21.444	54		393				21.34		
39	2015	West Virginia	1844128	512	27.764	28.909	380	20.606	21.188	132		403				21.853		
40	2016	West Virginia	1831102	640	34.952	37.719	340	18.568	19.678	300		393				21.462		
41	2017	West Virginia	1815857	795	43.781	47.155	304	16.741	17.169	491		391				21.533		
42	2018	West Virginia	1805832	681	37.711	41.087	234	12.958	13.136	447		313				17.333		
43	1999	Cabell County, WV	96987	NA	NA	NA	NA	NA	NA	NA		NA				NA		
44	2000	Cabell County, WV	96794	NA	NA	NA	NA	NA	NA	NA		NA				NA		
45	2001	Cabell County, WV	96035	12	NA	NA	NA	NA	NA	NA		12				12.495		
46	2002	Cabell County, WV	95741	15	NA	NA	12	NA	NA	3		15				15.667		
47	2003	Cabell County, WV	95554	15	NA	NA	NA	NA	NA	NA		15				15.698		

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
48	2004 Cabell County, WV	95239	17	NA	NA	13	NA	NA	4		17					17.85		
49	2005 Cabell County, WV	94821	NA	NA	NA	NA	NA	NA	NA		NA					NA		
50	2006 Cabell County, WV	94943	20	21.065	21.504	16	NA	NA	4		20	21	20	1	1	21.065		
51	2007 Cabell County, WV	95059	33	34.715	36.232	28	79.455	30.739	5		33	37	33	4	2	34.715		
52	2008 Cabell County, WV	95209	25	26.258	28.234	19	NA	NA	6		25	25	25	0	0	26.258		
53	2009 Cabell County, WV	96040	NA	NA	NA	NA	NA	NA	NA		NA	5	5	0	0	NA		
54	2010 Cabell County, WV	96319	23	23.879	24.379	23	23.879	24.379	0		23	75	33	2	1	23.879		
55	2011 Cabell County, WV	96653	29	30.004	33.106	26	26.9	29.945	3		29	36	29	7	4	30.004		
56	2012 Cabell County, WV	96974	18	NA	NA	18	NA	NA	0		18	22	18	4	2	18.562		
57	2013 Cabell County, WV	97133	26	26.767	29.733	24	24.708	27.261	2		24	42	24	18	10	24.708		
58	2014 Cabell County, WV	97109	32	32.953	36.773	27	27.804	31.095	5		28	45	28	17	9	28.834		
59	2015 Cabell County, WV	96844	48	49.564	54.777	29	29.945	33.151	19		32	69	32	37	20	33.043		
60	2016 Cabell County, WV	95987	69	71.885	82.521	29	30.212	34.944	40		36	87	36	51	27	37.505		
61	2017 Cabell County, WV	94958	124	130.584	147.851	34	25.274	27.482	100		42	132	42	90	48	44.23		
62	2018 Cabell County, WV	93224	104	111.559	126.316	17	NA	NA	87		32	105	32	73	39	34.326		

1 IN THE UNITED STATES DISTRICT COURT
2 FOR THE SOUTHERN DISTRICT OF WEST VIRGINIA

3 * * * * *

4 THE CITY OF HUNTINGTON,

5 Plaintiff,

6 vs.

 CIVIL ACTION
7 NO. 3:17-01362

8 AMERISOURCEBERGEN DRUG
9 CORPORATION, et al.,
10 Defendants.

11 CABELL COUNTY COMMISSION,
12 Plaintiff,

13 vs.

 CIVIL ACTION
 NO. 3:17-01665

14 AMERISOURCEBERGEN DRUG
15 CORPORATION, et al.,
 Defendants.

16 * * * * *

17
18
19 Videotaped and videoconference personal
20 and 30(b)(6) deposition of DR. ALLEN MOCK AS
21 REPRESENTATIVE OF THE WEST VIRGINIA STATE MEDICAL
22 OFFICE taken by the Defendants under the Federal
23 Rules of Civil Procedure in the above-entitled
24 action, pursuant to notice, before Teresa S. Evans,
 a Registered Merit Reporter, all parties located
 remotely, on the 14th day of August, 2020.

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1 Code §61-12."

2 Do you agree that this is the mission
3 of OCME?

4 A. Yes.

5 Q. And what cases fall within the jurisdiction
6 of OCME?

7 A. Cases that are unnatural, those that
8 involve nonnatural causes.

9 Q. And are every -- is every case that is
10 nonnatural referred to the OCME?

11 A. Yes.

12 Q. Okay. Who determines whether a death is
13 natural or unnatural?

14 A. First, the physician -- it's the treating
15 physician's responsibility to notify the OCME.
16 They do their best job at that. But occasionally,
17 we're not notified of a death that could escape our
18 -- our jurisdiction.

19 Typically, the call will come in from
20 either the physician's office or the hospital or
21 hospice or from emergency medical services, or
22 maybe even the county medical examiner directly.

23 That goes to the FIU, the forensic
24 investigators in-house. They will confer with the

1 physician on call if necessary and bring the case
2 in based upon the case circumstances, the
3 individual case features.

4 Q. Okay. So then would any suspected drug
5 overdose case be within the jurisdiction of OCME?

6 A. It depends on who has determined it to be
7 suspicious or suspected. But all -- all suspected
8 toxicology-related deaths will come to the OCME.

9 Q. Okay. You talked about treating physicians
10 referring the deaths to OCME, the hospital,
11 hospice, ER, county medical examiners. Are there
12 any other entities that report deaths to OCME?

13 A. Those are the primary ones. There are
14 instances where a funeral home will call the OCME
15 when they see something that they suspect is injury
16 in a case that was not reported to the OCME, but
17 it's -- it's typically from a hospital setting.

18 Q. Okay. How about nursing homes?

19 A. Nursing homes, certainly.

20 Q. How about law enforcement?

21 A. Law enforcement, certainly.

22 Q. Okay. Any other entities that you could
23 think of that refer cases to the OCME?

24 A. Anybody that attends a death could

1 A. I said before that the -- the opinion, the
2 interpretation, is somewhat subjective, whereas the
3 observations are made at autopsy. I think that you
4 need to go in with the understanding that
5 everything has uncertainty attached to it, which is
6 why I hate that reasonable degree of medical
7 certainty that lawyers love.

8 I think everything has uncertainty and
9 that increases the uncertainty. With a large
10 postmortem redistribution effect, the uncertainty
11 needs to be increased.

12 Whether that will affect ultimately
13 your cause and manner of death is an interpretive
14 issue that the doctor needs to address.

15 Q. And so if you didn't feel comfortable
16 putting fentanyl on based on your knowledge based
17 on the redistribution of fentanyl, what would you
18 write on the death certificate?

19 A. I would either place it in -- in Part II as
20 a other significant contributory factor. I could
21 add qualifiers to it. I could say "possible,"
22 "probable," "likely," "fentanyl intoxication." I
23 could do the same in Part II as a contributor.

24 In "How injury occurred", I could

1 mention "cannot exclude the contribution of
2 fentanyl." There's are a lot of ways that I can
3 de-emphasize my certainty in a fentanyl
4 intoxication.

5 Q. Could you put "unknown opioid" on there?
6 Is that a possibility?

7 A. That's frowned upon, but you could.
8 Instances like that, I usually prefer to write --
9 suppose we had a urine drug screen that was -- it
10 just said, "Opioids positive." They can't
11 differentiate between the two. If I have nothing
12 else, I might say, "Opioid intoxication" in
13 parentheses, "(clinical)," to indicate that I
14 didn't perform the test.

15 Q. Okay.

16 A. The impetus is to record all of the drugs
17 on the -- on Part I in a lethal drug intoxication,
18 and there's a long history behind that, and it
19 takes a lot of getting used to, but that is the
20 kind of generalized accepted position.

21 Q. And when you -- you say "record all the
22 drugs." Do you record on the death certificate all
23 the drugs that are in a person's system or all the
24 drugs that were at such a level that in and of

1 themselves, they would have been lethal?

2 A. All of the drugs.

3 Q. Okay.

4 A. Currently. Now, historically -- West
5 Virginia was actually ahead of the curve on this,
6 where they recorded a lot more drugs in Part I than
7 other offices might, and over time, they've all
8 adopted it with very rare exceptions.

9 And I say it takes some getting used to
10 because you might have disparate mechanisms in
11 drugs. I might have Amphetamine and an opioid as a
12 combined intoxication, and as a physician, knowing
13 that the pharmacology is vastly different, it takes
14 a little getting used to.

15 But I think the data that you're
16 ultimately able to mine when you capture all of the
17 drugs could be important from a public health
18 standpoint.

19 Q. Okay. So on a death certificate, if it
20 lists an opioid -- regardless of the opioid -- it
21 doesn't necessarily mean that that opioid in and of
22 itself would have been lethal to that decedent.

23 A. In the rare case where a clinical opioid
24 intoxication would make it to the DC, I think

1 that's all you could say about it. In a -- one
2 that's issued by our office where it has a combined
3 intoxication by a disparate range of drugs, you
4 could not say that one drug out of the mixture was
5 responsible for the death.

6 You could insinuate it if other drugs
7 were in low concentrations and one single drug was
8 in variable remarkably high concentrations, but as
9 a rule, no, you can't -- you can't differentiate
10 between which was the cause of death ultimately.

11 Q. And in drug intoxication cases, it's
12 frequent that there's more than one drug in a
13 decedent's system, correct?

14 A. Very frequent.

15 Q. And that's the problem with it, that you
16 can't tell which one was the actual ultimate cause
17 of death for the decedent because there's more than
18 one.

19 MS. KEARSE: Object to form.

20 A. You can determine -- so let's say that
21 someone dies from something -- from -- the scene
22 shows that someone died from a sudden collapse.
23 Although fentanyl has been published to cause a
24 sudden death-like reaction, that's not the norm for

1 opioids. You would expect more somnolence,
2 respiratory depression, death in your sleep.
3 Whereas for methamphetamine, you might suspect an
4 arrhythmia and a sudden death.

5 So if you have someone that's
6 somnolent, they're heard snoring and then they stop
7 snoring and they die and you have a little bit of
8 methamphetamine and a whole lot of fentanyl, you're
9 safe to say that it was the fentanyl that
10 reasonably caused the death.

11 But the Amphetamine would still be
12 listed in Part I. So when you're reviewing the
13 death certificate, it would be difficult for you to
14 say which one just on the basis of the death
15 certificate. Which is good for data mining, but
16 bad for a physician reviewer that has to, you know,
17 interpret that.

18 Q. So in addition to the death certificate,
19 would I need information from the autopsy report,
20 the toxicology report and kind of the whole autopsy
21 file to get a whole picture?

22 A. Yeah, the Vital Statistics is a -- is a
23 governmental function just like the manner of
24 death. You know, they -- what you put on the death

1 certificate, there's no guarantee that that will
2 end up in the Vital Statistics database the way
3 it's written, because they code things a certain
4 way.

5 So the most reliable coding strategy to
6 trace -- to transmit the doctor's opinion is by
7 aggressively using Part I to list all the drugs
8 that were present.

9 You may have an opportunity in Part --
10 in "How Injury Occurred" to say, "Abused fentanyl
11 by intravenous route" or you might have to say,
12 "Abused illicit methamphetamine; prescribed
13 Oxycodone," so it's unmanageable and it -- it takes
14 some time to get used to, but I still think it's
15 the most prudent.

16 Q. So we talked a lot about fentanyl. How do
17 you test -- or can --

18 MS. ZERRUSEN: Strike that.

19 Q. Can OCME test to determine whether fentanyl
20 was prescription fentanyl, illicitly-manufactured
21 fentanyl or fentanyl analogs?

22 A. There are ways to distinguish all of those.
23 They're not perfect. There's uncertainty involved.
24 Prescription fentanyl will be fentanyl alone with

1 A. Correct.

2 Q. And a different medical examiner can look
3 at the same information for a decedent and come up
4 with a different cause of death?

5 A. They certainly can.

6 Q. Okay. We talked about many different
7 substances being in a decedent's tox screen, but
8 I'm not sure that we -- we used the word "poly
9 pharmacy" earlier. What is poly pharmacy?

10 A. Poly pharmacy is a popular cause of death
11 in some areas and some offices, not ours. It runs
12 counter to the instructions that are listed here.
13 That's used to describe a combined intoxication.
14 It allows the author of the DC to say, "Multiple
15 drugs were in the system" but not be any more
16 specific.

17 So it's coded as an accidental
18 overdose, but very little information about the
19 individual drugs are captured.

20 Q. Okay. And OCME wants to capture every
21 single drug that is found in a decedent's tox
22 screen?

23 A. Every drug that has a -- a relevance. For
24 example, I won't include nicotine or caffeine, for

1 example, unless there's, you know, a reason to. So
2 any drugs that have a significant pharmacologic
3 reaction.

4 Q. Is it possible to overdose on caffeine?

5 A. Yes.

6 Q. Wow. That's bad to know, especially the
7 amount of coffee that I drink.

8 A. You have to try really hard though.

9 Q. Okay. Earlier, we talked about tolerance
10 and tolerance levels. Is your testimony regarding
11 tolerance and tolerance levels earlier the
12 testimony of OCME as well?

13 A. Yes.

14 Q. And earlier, we talked about manner of
15 death and how it is classified and what -- what
16 goes into determining manner of death?

17 Is all of your testimony earlier
18 regarding manner of death also the testimony of
19 OCME?

20 A. Yes, that's office policy.

21 Q. Okay. Similarly, we test -- you testified
22 earlier regarding suicides and several different
23 aspects that go into determining suicides, stigma
24 of suicide. Is all of your earlier testimony



National Center for Health Statistics



Vital Statistics Rapid Release

Provisional Drug Overdose Death Counts

Provisional Drug Overdose Death Counts

Recent improvements in timeliness and data quality have prompted a re-evaluation of the length of time that data quality requirements have had to be met for states to be included in "Figure 2. 12 Month-ending Provisional Number of Drug Overdose Deaths by Drug or Drug Class." As a result of this re-evaluation, trends for additional states are presented in Figure 2. Additional states will be added as they meet data quality and timeliness requirements. Please see the **Technical Notes** of the dashboard for more information.

This data visualization presents provisional counts for drug overdose deaths based on a current flow of mortality data in the National Vital Statistics System. Counts for the most recent final annual data are provided for comparison. National provisional counts include deaths occurring within the 50 states and the District of Columbia as of the date specified and may not include all deaths that occurred during a given time period. Provisional counts are often incomplete and causes of death may be pending investigation (see [Technical notes](#)) resulting in an underestimate relative to final counts. To address this, methods were developed to adjust provisional counts for reporting delays by generating a set of predicted provisional counts (see [Technical notes](#)).

The provisional data presented in this visualization include: (a) the reported and predicted provisional counts of deaths due to drug overdose occurring nationally and in each jurisdiction; (b) a U.S. map of the percentage changes in provisional drug overdose deaths for the current 12 month-ending period compared with the 12-month period ending in the same month of the previous year, by jurisdiction; and (c) the reported and predicted provisional counts of drug overdose deaths involving specific drugs or drug classes occurring nationally and in selected jurisdictions. The reported and predicted provisional counts represent the numbers of deaths due to drug overdose occurring in the 12-month periods ending in the month indicated. These counts include all seasons of the year and are insensitive to variations by seasonality. Deaths are reported by the jurisdiction in which the death occurred.

Several data quality metrics, including the percent completeness in overall death reporting, percentage of deaths with cause of death pending further investigation, and the percentage of drug overdose deaths with specific drugs or drug classes reported are included to aid in interpretation of provisional data as these measures are related to the accuracy of provisional counts (see [Technical notes](#)). Reporting of the specific drugs and drug classes involved in drug overdose deaths varies by jurisdiction, and comparisons of death rates involving specific drugs across selected jurisdictions should not be made (see [Technical notes](#)). Provisional data presented in this visualization will be updated on a monthly basis as additional records are received.

Options

Select a dashboard:

12 Month-ending Provisional Counts and Percent Change of Drug (▼)

[Update Dashboard](#)

Download Datasets:

- [CSV Format](#)
- [Data.CDC.gov](#)
(Export to CSV, JSON, XLS, XML)

12 Month-ending Provisional Number of Drug Overdose Deaths

NOTE: Visualization is optimized for a viewing screen of 950 pixels or wider (i.e., PC and tablets in landscape orientation).



12 Month-ending Provisional Counts of Drug Overdose Deaths - The following data tables describe the currently displayed dashboard
click the titlebars to expand / collapse Data tables

► Data Table for Figure 1a. 12 Month-ending Provisional Counts of Drug Overdose Deaths

► Data Table for Figure 1b: Percent Change in 12 Month-ending Count of Drug Overdose Deaths, by Jurisdiction

Technical notes

Nature and sources of data

Provisional drug overdose death counts are based on death records received and processed by the National Center for Health Statistics (NCHS) as of a specified cutoff date. The cutoff date is generally the first Sunday of each month. National provisional estimates include deaths occurring within the 50 states and the District of Columbia. NCHS receives the death records from state vital registration offices through the Vital Statistics Cooperative Program (VSCP).

The timeliness of provisional mortality surveillance data in the National Vital Statistics System (NVSS) database varies by cause of death. The lag time (i.e., the time between when the death occurred and when the data are available for analysis) is longer for drug overdose deaths compared with other causes of death (1). Thus, provisional estimates of drug overdose deaths are reported 6 months after the date of death.

Provisional death counts presented in this data visualization are for “12-month ending periods,” defined as the number of deaths occurring in the 12-month period ending in the month indicated. For example, the 12-month ending period in June 2017 would include deaths occurring from July 1, 2016, through June 30, 2017. The 12-month ending period counts include all seasons of the year and are insensitive to reporting variations by seasonality. Counts for the 12-month period ending in the same month of the previous year are shown for comparison. These provisional counts of drug overdose deaths and related data quality metrics are provided for public health surveillance and monitoring of emerging trends. Provisional drug overdose death data are often incomplete, and the degree of completeness varies by jurisdiction and 12-month ending period. Consequently, the numbers of drug overdose deaths are underestimated based on provisional data relative to final data and are subject to random variation. Methods to adjust provisional counts have been developed to provide *predicted* provisional counts of drug overdose deaths (2), accounting for delayed reporting (see [Percentage of records pending investigation](#) and [Adjustments for delayed reporting](#)).

Provisional data are based on available records that meet certain data quality criteria at the time of analysis and may not include all deaths that occurred during a given time period. Therefore, they should not be considered comparable with final data and are subject to change.

Cause-of-death classification and definition of drug deaths

Mortality statistics are compiled in accordance with World Health Organization (WHO) regulations specifying that WHO member nations classify and code causes of death with the current revision of the *International Statistical Classification of Diseases and Related Health Problems* (ICD). ICD provides the basic guidance used in virtually all countries to code and classify causes of death. It provides not only disease, injury, and poisoning categories but also the rules used to select the single underlying cause of death for tabulation from the several diagnoses that may be reported on a single death certificate, as well as definitions, tabulation lists, the format of the death certificate, and regulations on use of the classification. Causes of death for data presented in this report were coded according to ICD guidelines described in annual issues of Part 2a of the NCHS Instruction Manual (3).

Drug overdose deaths are identified using underlying cause-of-death codes from the Tenth Revision of ICD (ICD-10): X40–X44 (unintentional), X60–X64 (suicide), X85 (homicide), and Y10–Y14 (undetermined). Drug overdose deaths involving selected drug categories are identified by specific multiple cause-of-death codes. Drug categories presented include: heroin (T40.1); natural opioid analgesics, including morphine and codeine, and semisynthetic opioids, including drugs such as oxycodone, hydrocodone, hydromorphone, and oxymorphone (T40.2); methadone, a synthetic opioid (T40.3); synthetic opioid analgesics other than methadone, including drugs such as fentanyl and tramadol (T40.4); cocaine (T40.5); and psychostimulants with abuse potential, which includes methamphetamine (T43.6). Opioid overdose deaths are identified by the presence of any of the following MCOD codes: opium (T40.0); heroin (T40.1); natural opioid analgesics (T40.2); methadone (T40.3); synthetic opioid analgesics other than methadone (T40.4); or other and unspecified narcotics (T40.6). This latter category includes drug overdose deaths where ‘opioid’ is reported without more specific information to assign a more specific ICD-10 code (T40.0–T40.4) (4,5). Among deaths with an underlying cause of drug overdose, the percentage with at least one drug or drug class specified is defined as that with at least one ICD-10 multiple cause-of-death code in the range T36–T50.8. Two additional categories were added based on CDC’s Opioid Overdose Indicator Support Toolkit (6): drug overdose deaths involving natural, semi-synthetic, or synthetic opioids, including methadone (T40.2–T40.4); drug overdose deaths involving natural and semi-synthetic opioids, and methadone (T40.2–T40.3). These new categories, which are a combination of existing categories, are not displayed on the default figure to facilitate ease of display of the main drug categories, but are accessible through the drop-down box that allows for selection of specific drug categories.

Drug overdose deaths may involve multiple drugs; therefore, a single death might be included in more than one category when describing the number of drug overdose deaths involving specific drugs. For example, a death that involved both heroin and fentanyl would be included in both the number of drug overdose deaths involving heroin and the number of drug overdose deaths involving synthetic opioids other than methadone.

Selection of specific states and other jurisdictions to report

Provisional counts are presented by the jurisdiction in which the death occurred (i.e., the reporting jurisdiction). Data quality and timeliness for drug overdose deaths vary by reporting jurisdiction. Provisional counts are presented for reporting jurisdictions based on measures of data quality: the percentage of records where the manner of death is listed as “pending investigation,” the overall completeness of the data, and the percentage of drug overdose death records with specific drugs or drug classes recorded. These criteria are defined below.

Percentage of records pending investigation

Drug overdose deaths often require lengthy investigations, and death certificates may be initially filed with a manner of death “pending investigation” and/or with a preliminary or unknown cause of death. When the percentage of records reported as “pending investigation” is high for a given jurisdiction, the number of drug overdose deaths is likely to be underestimated. For jurisdictions reporting fewer than 1% of records as “pending investigation”, the provisional number of drug overdose deaths occurring in the fourth quarter of 2015 was approximately 5% lower than the final count of drug overdose deaths occurring in that same time period. For jurisdictions reporting greater than 1% of records as “pending investigation” the provisional counts of drug overdose deaths may underestimate the final count of drug overdose deaths by as much as 30%. Thus, jurisdictions are included in Figure 2 if 1% or fewer of their records in NVSS are reported as “pending investigation,” for the six most recent 12-month ending periods. For jurisdictions not meeting quality measures for all periods starting with January 2015, predicted values are shown for all data points that meet percent completeness and drug specificity thresholds with reported values only shown for months where all three data quality measures were met. As a result, estimates are shown for selected reporting periods before the most recent 6 months and there may be gaps in the trends. Values for records pending investigation are updated with each monthly release and reflect the most current data available.

Percent completeness

NCHS receives monthly counts of the estimated number of deaths from each jurisdictional vital registration offices (referred to as “control counts”). This number represents the best estimate of how many deaths occurred in a given jurisdiction in each month. Death records in the NVSS database must have both demographic and coded cause-of-death information. The percent completeness is obtained by dividing the number of death records in the NVSS database for each jurisdiction for each 12-month period by the control counts and multiplying by 100. For more information on completeness, see [Technical Notes of the Vital Statistics Rapid Release Program](#). Jurisdictions are included in Figure 2 if the percent completeness was consistently 90% or higher following a 6-month lag for the 12-month ending periods included in the dashboard.

Drug specificity

The percentage of death records in which a specific drug or drug class is identified as involved in a drug overdose death varies by jurisdiction (7). Selected jurisdictions consistently had 90% or more of drug overdose death certificates mentioning at least one specific drug for all of the 12-month ending periods included in the dashboard. Provisional counts of drug overdose deaths where a specific drug or drug class is reported on the death certificate are presented for the United States and for jurisdictions meeting this threshold. Additionally, as a data quality metric, the percentage of drug overdose death records where at least one drug or drug class is recorded is presented.

Improvements in Data Quality

In order for information on drug-specific overdose deaths to be reported by jurisdiction in the NCHS Vital Statistics Rapid Release Monthly Provisional Drug Overdose Death dashboard, states have been required to meet a set of timeliness and quality criteria consistently for each time point in the long-term trend line shown (starting with January 2015). Improvements in timeliness and data quality over the last year have prompted a re-evaluation of the length of time that data quality requirements have had to be met for states to be included in “Figure 2. 12 Month-ending Provisional Number of Drug Overdose Deaths by Drug or Drug Class.” As a result of this re-evaluation, additional states will be added to “Figure 2. 12 Month-ending Provisional Number of Drug Overdose Deaths by Drug or Drug Class” as they meet the data quality and timeliness requirements. Some states may also drop out of the figure for a given month if they fall below data quality criteria.

As the timeliness and data quality of the drug overdose mortality data improve, the list of included jurisdictions will be re-examined to determine whether additional jurisdictions should be included or excluded based on the criteria described above. Due to reporting variations by jurisdiction, comparisons across selected jurisdictions should not be made. Data quality measures are shown for all jurisdictions in the below table. Values are updated with each monthly release and reflect the most current data available.

The following data quality table is available in a CSV format. [Click here](#) to download.

► Data Quality Measures for All Jurisdictions

Adjustments for delayed reporting

Provisional counts of drug overdose deaths are underestimated relative to final counts. The degree of underestimation is determined primarily by the percentage of records with the manner of death reported as “pending investigation” and tends to vary by reporting jurisdiction, year, and month of death. Specifically, the number of drug overdose deaths will be underestimated to a larger extent in jurisdictions with higher percentages of records reported as “pending investigation,” and this percentage tends to be higher in more recent months.

Methods were developed to adjust provisional counts for reporting delays related to temporal factors (i.e., 12 month-ending period) and the percentage of records that are reported with manner of death “pending investigation” (2). Briefly, these methods involve developing ‘multiplication factors’ based on the degree of underreporting in provisional data compared with final data. For example, if provisional counts of drug overdose deaths were historically 90% complete relative to final data, then the multiplication factor in this instance would be 1.1. The reported provisional counts can be multiplied by this factor to generate a set of *predicted* provisional counts that adjust for reporting delays.

The 12 month-ending period and the percentage of records with manner of death reported as “pending investigation” were used to predict the degree of underreporting in provisional data relative to final. Results from these models were used to generate a set of multiplication factors that could be applied to the reported provisional counts of drug overdose deaths to estimate *predicted* provisional counts. These predicted provisional counts may represent a more accurate picture of recent trends by accounting for reporting delays related to the percentage of records in provisional data with manner of death “pending investigation.” It is important to note that flat or declining numbers of drug overdose deaths (either reported or predicted) could be due to incomplete data, true decreases in the number of deaths, or a combination of the two. True declines or plateaus in the numbers of drug overdose deaths across the U.S. cannot be ascertained until final data become available.

Timeliness of drug overdose death reporting has improved in recent years. Adjustments for delayed reporting are based on final data from 2018. Relative to final data, 12-month ending provisional counts of drug overdose deaths for 2018 were 97% to 99% complete after a 6-month lag. The degree of underestimation was largest for 12-month periods ending in August and September, where provisional counts were approximately 98% of final counts, on average. Patterns were similar to those seen for 2017 data, but completeness was slightly higher in 2018. With improvements in reporting and completeness, predicted values will be closer to reported values and the completeness of reported drug overdose death counts may be higher than in prior years.

▼ Table 1. Completeness of 12-month ending provisional counts of drug overdose deaths relative to final counts from 2018 after six month lag, by reporting jurisdiction and ending month

Reporting jurisdiction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
United States	99.3	98.8	98.7	98.8	98.4	98.3	98.1	97.9	97.9	98.2	98.8	99.7
Alabama	100	98.5	98.6	98.2	86.8	99.3	99.2	99.1	99.1	99.7	100	100
Alaska	100	99.3	99.3	99.3	99.2	99.2	99.1	100	100	100	100	100
Arizona	99.6	99.4	99.4	99.5	99.3	99.3	99.2	99.5	99.5	99.6	99.4	99.9
Arkansas	99.5	99.5	99.5	99.5	99.5	99.1	98.7	98.7	98.7	98.7	99.1	99.8
California	98.5	97.4	96.5	96.4	96.2	96.3	96	94.6	92.1	96.2	98.2	98.9
Colorado	100	100	99.9	99.8	99.8	99.8	99.9	99.8	99.8	99.9	99.9	100
Connecticut	99.4	98.7	98.4	98.1	97.4	96.2	95.9	98.4	98.3	99.4	98.5	100
Delaware	100	100	99.7	99.7	100	100	100	100	100	100	100	100
District of Columbia	99.4	99.7	99.7	99.3	97.9	98.6	98.6	98.6	98.3	98.7	99.7	100
Florida	99.5	99.1	99.2	99.2	99.5	99.6	99.6	99.4	99.6	99.7	99.9	100
Georgia	99.7	99.7	99.7	99.4	99.4	99.6	99.6	99.7	99.5	99.3	99.6	100
Hawaii	100	100	99.5	99.6	99.5	99.5	99.5	100	99.5	99.1	97.7	100

Reporting jurisdiction	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Idaho	99.6	99.6	100	99.6	99.6	98.7	97.6	98.4	98.3	97.8	100	100
Illinois	100	99.9	100	100	99.9	99.9	99.8	99.8	99.9	99.9	99.9	100
Indiana	99.7	99.2	98.9	98.6	98.5	98.3	98.4	98.8	98.7	98.2	97.9	99.5
Iowa	100	99.7	100	100	100	99.7	99.3	99.3	99	99.3	99.3	99.3
Kansas	100	100	100	100	100	99.7	99.4	99.7	99.7	99.7	99.7	100
Kentucky	99.9	99.7	99.7	99.5	99.7	99.6	99.9	99.8	99.9	99.9	99.9	99.9
Louisiana	99.9	99.5	99.6	99.8	99.8	99.8	99.8	99.8	99.9	100	100	100
Maine	100	100	100	100	100	100	99.8	99.8	99.7	99.5	99.5	99.7
Maryland	99.6	99.7	99.9	100	100	100	100	100	100	99.9	99.9	100
Massachusetts	99.9	99.9	99.5	100	99.9	100	100	100	99.9	99.7	99.6	99.9
Michigan	96	93.6	98.3	98.2	97.9	97.7	96.8	97.3	97.2	97.3	98.2	99.8
Minnesota	100	99.7	100	100	99.9	99.9	99.9	99.6	99.5	99.5	99.8	99.8
Mississippi	97.2	96.1	93	92.4	91.1	96.1	93.8	92.9	94.6	99	100	100.3
Missouri	99.9	99.6	99.4	99.7	99.7	99.8	99.8	100	100	100	100	99.9
Montana	97.4	97.1	98	99	100	98.1	98.1	99.1	98.2	99.1	100	100
Nebraska	100	100	100	100	100	100	100	100	100	100	100	100
Nevada	99.9	99.6	99.7	99.7	99.6	99.9	99.9	99.5	99.5	99.3	99.4	100
New Hampshire	99.8	99.4	96.9	95.1	95.1	94.9	94.7	94.7	93.4	88.8	100	100
New Jersey	99.2	99	98.6	98.7	98.5	98.6	98.2	97.7	97.9	98.1	98.8	99.5
New Mexico	97.8	97.9	98.1	98.1	96.9	97.2	98.4	98	97.7	98.4	99.2	98.7
New York ¹	98	96.6	96.1	98.9	99.1	99.3	99.3	99.4	99.7	99.1	98.4	98.7
New York City	99.3	99.1	98.9	98.8	97.6	96.5	94.8	97.9	97.4	98.3	99.1	99.5
North Carolina	98.3	97.5	96.5	98.3	97.3	95.5	94.7	93.8	93.7	93.6	97.5	98
North Dakota	100	100	100	100	100	97.2	97.1	95.5	87.5	85.1	78.9	100
Ohio	99.9	99.8	99.6	99.6	99.6	99.7	99.8	99.8	99.9	99.9	99.8	99.9
Oklahoma	99.7	99.3	100	99.7	99.5	99.3	99.1	99	99.3	99.2	99.9	100
Oregon	99.8	99.4	99.6	98.9	99.6	99.8	99.5	99.8	99.8	100	99.8	100
Pennsylvania	99.2	99.4	99.3	99.1	98.9	98.2	98.7	98.5	98.6	98.8	99.5	99.9
Rhode Island	100	99.7	98.7	98.7	95.7	90.7	87.3	85.4	85.1	85.3	85.3	100
South Carolina	99.5	98.3	97.8	97.7	97.7	97.7	96.9	95.8	96.7	96.6	97.7	99.7
South Dakota	100	100	100	98.4	98.4	96.8	98.4	98.3	98.2	98.3	98.2	100
Tennessee	99.4	99.1	98.6	98	97.5	97.3	97.1	96.8	97.3	97.1	97.4	99.7
Texas	99.8	99.7	99.4	99.3	99.3	99.1	98.7	98.3	97.6	95.8	99	99.6
Utah	99.7	99.8	99.7	100	100	99.7	99.3	99.3	99.1	98.8	99.4	99.8
Vermont	100	100	100	100	100	100	100	100	100	100	100	100
Virginia	100	100	100	100	98.9	98.8	98.8	98.8	98.6	98.7	98.6	100
Washington	99.9	99.3	98.4	97.9	95.3	92.4	90.9	90.5	92.9	93.2	94.3	99.1
West Virginia	97.3	94.6	91.3	87.8	84	82.2	79	77.9	86.3	89.3	89.3	99.4
Wisconsin	99.4	98	96.8	98.5	98.4	99.6	99.4	99	99.1	99.2	99.6	99.7
Wyoming	96.8	96.9	100	100	100	100	100	100	100	100	100	100

¹Excludes New York City.

NOTE: Completeness of weekly provisional data is shown with a 6-month lag following the 12-month period ending in the month indicated.

SOURCE: NCHS, National Vital Statistics System, 2018.

Coefficients from these updated models were used to update the multiplication factors applied to the reported provisional counts of drug overdose deaths. Model results for each of the ten drug outcomes of interest are presented below.

▼ Table 2. Model results of the completeness of provisional data by month-ending and percent pending: Drug overdose deaths and deaths involving any opioid. Values are estimated coefficients (robust standard errors).

Model Parameters	Drug overdose	Any opioids (T40.0-T40.4,T40.6)	Natural, semi-synthetic, and synthetic opioids, including methadone (T40.2-T40.4)	Natural & semi-synthetic opioids and methadone (T40.2-T40.3)
Intercept	101 (0.1)	100.9 (0.1)	100.9 (0.1)	100.6 (0.1)
Feb	-0.3 (0)	-0.4 (0.1)	-0.5 (0.1)	-0.6 (0.1)
Mar	-0.7 (0.1)	-0.8 (0.1)	-0.9 (0.1)	-0.9 (0.1)
Apr	-0.6 (0.1)	-0.8 (0.1)	-0.9 (0.1)	-0.8 (0.1)
May	-0.7 (0.1)	-0.8 (0.1)	-0.9 (0.1)	-0.8 (0.1)
Jun	-0.6 (0.1)	-0.7 (0.1)	-0.8 (0.1)	-0.7 (0.1)
Jul	-0.7 (0.1)	-0.7 (0.1)	-0.8 (0.1)	-0.7 (0.1)
Aug	-0.8 (0.1)	-0.8 (0.1)	-0.8 (0.1)	-0.8 (0.1)
Sep	-0.6 (0.1)	-0.7 (0.1)	-0.7 (0.1)	-0.8 (0.1)
Oct	-0.7 (0.1)	-0.8 (0.1)	-0.8 (0.1)	-0.8 (0.1)
Nov	-0.5 (0.1)	-0.5 (0.1)	-0.5 (0.1)	-0.4 (0.1)
Dec	-0.3 (0.1)	-0.3 (0.1)	-0.2 (0.1)	-0.1 (0.1)
Percent Pending	-11.9 (0.1)	-11.8 (0.1)	-12.1 (0.1)	-10.3 (0.1)

SOURCE: NCHS, National Vital Statistics System, 2016-2018.

▼ Table 3. Model results of the completeness of provisional data by month-ending and percent pending: deaths involving specific drugs and drug classes. Values are estimated coefficients (robust standard errors).

Model Parameters	Heroin (T40.1)	Natural & semi-synthetic opioids (T40.2)	Methadone (T40.3)	Synthetic opioids, excl. methadone (T40.4)	Cocaine (T40.5)	Psychostim. w/ abuse potential (T43.6)
Intercept	100.9 (0.1)	100.6 (0.1)	100.4 (0.1)	100.6 (0.1)	100.7 (0.1)	100.3 (0.1)
Feb	-0.3 (0.1)	-0.5 (0.1)	-0.6 (0.1)	-0.4 (0.1)	-0.4 (0.1)	-0.5 (0.1)
Mar	-0.8 (0.1)	-0.9 (0.1)	-1 (0.1)	-0.8 (0.1)	-0.7 (0.1)	-0.8 (0.1)
Apr	-0.8 (0.1)	-0.8 (0.1)	-1 (0.1)	-0.7 (0.1)	-1.2 (0.2)	-0.7 (0.1)
May	-0.9 (0.1)	-0.8 (0.1)	-1.1 (0.1)	-0.8 (0.1)	-1.5 (0.2)	-0.8 (0.1)
Jun	-0.8 (0.1)	-0.7 (0.1)	-0.7 (0.1)	-0.5 (0.1)	-1.2 (0.2)	-0.6 (0.1)
Jul	-0.9 (0.1)	-0.7 (0.1)	-0.7 (0.1)	-0.6 (0.1)	-1.2 (0.2)	-0.7 (0.1)
Aug	-0.9 (0.1)	-0.8 (0.1)	-0.7 (0.1)	-0.6 (0.1)	-1 (0.2)	-0.6 (0.1)
Sep	-0.6 (0.1)	-0.9 (0.1)	-0.8 (0.1)	-0.4 (0.1)	-0.6 (0.2)	-0.4 (0.1)
Oct	-0.8 (0.1)	-0.9 (0.1)	-0.7 (0.1)	-0.6 (0.1)	-0.6 (0.2)	-0.6 (0.1)
Nov	-0.6 (0.1)	-0.5 (0.1)	-0.3 (0.1)	-0.4 (0.1)	-0.2 (0.2)	-0.1 (0.1)
Dec	-0.3 (0.1)	-0.1 (0.1)	0 (0.1)	-0.1 (0.1)	0 (0.1)	0.2 (0.1)
Percent Pending	-11.1 (0.1)	-10.3 (0.1)	-9.9 (0.1)	-12.4 (0.1)	-11.5 (0.2)	-11.4 (0.1)

SOURCE: NCHS, National Vital Statistics System, 2016-2018.

Differences between final and provisional data

There may be slight differences between provisional and final data for a given data year (e.g., 2019). Final drug overdose death data published annually through NCHS statistical reports (8) and CDC WONDER are typically tabulated by state of residence and limited to residents of the United States. Provisional data, such as the Drug Overdose Death Counts released through the Vital Statistics Rapid Release (VSRR) program, include all deaths that occurred within the 50 states and the District

of Columbia, including foreign residents. As such, provisional counts include approximately 400-500 additional drug overdose death records where the decedents were not US residents. Provisional data are tabulated by state of occurrence to capture the burden on the place where the deaths occur, and to correspond to the various data quality metrics that are provided.

Additionally, in July/August following the end of a given data year, the final file is 'closed' in order to produce the historical and public use files and reports. After it is considered closed, the final file is no longer updated, even if additional updates or records are received from the jurisdictions. The result is that some records that are in the final annual file may still list an unknown cause of death or manner of death indicating 'pending investigation.' The provisional data continues to be updated as additional cause of death information is received, and the counts may increase in response to these changes. As a result, provisional drug overdose death counts published in the VSRR for the 2019 data year (i.e., 12-month ending period in Dec 2019) may differ from the counts published using the 2019 final data. The size of the discrepancy is typically small (approximately 200 additional drug overdose death records in the provisional data that were 'pending investigation' or had an unknown cause of death in the final data).

Source

NCHS, National Vital Statistics System. Estimates for 2019 and 2020 are based on provisional data. Estimates for 2015-2018 are based on final data (available from: https://www.cdc.gov/nchs/nvss/mortality_public_use_data.htm).

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Suggested citation

Ahmad FB, Rossen LM, Sutton P. Provisional drug overdose death counts. National Center for Health Statistics. 2020.

Designed by LM Rossen, A Lipphardt, FB Ahmad, JM Keralis, and Y Chong: National Center for Health Statistics.

Page last reviewed: November 12, 2020

Estimating the Number of People Who Inject Drugs in A Rural County in Appalachia


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Objectives. To demonstrate how we applied the capture–recapture method for population estimation directly in a rural Appalachian county (Cabell County, WV) to estimate the number of people who inject drugs (PWID).

Methods. We conducted 2 separate 2-week periods of data collection in June (“capture”) and July (“recapture”) 2018. We recruited PWID from a syringe services program and in community locations where PWID were known to congregate. Participants completed a survey that included measures related to sociodemographics, substance use, and HIV and hepatitis C virus prevention.

Results. In total, 797 surveys were completed; of these surveys, 49.6% ($n = 395$) reflected PWID who reported injection drug use in the past 6 months and Cabell County residence. We estimated that there were 1857 (95% confidence interval = 1147, 2567) PWID in Cabell County. Among these individuals, most reported being White (83.4%), younger than 40 years (70.9%), and male (59.5%). The majority reported injecting heroin (82.0%), methamphetamine (71.0%), and fentanyl (56.3%) in the past 6 months.

Conclusions. Capture–recapture methods can be applied in rural settings to estimate the size of PWID populations. (*Am J Public Health.* 2019;109:445–450. doi:10.2105/AJPH.2018.304873)

 See also Pollini, p. 354.

The opioid epidemic has had far-reaching consequences across the United States. Provisional data suggest that more than 72 000 overdose fatalities occurred in 2017. Among these deaths, an estimated 49 068 involved opioids.¹ This epidemic has had disproportionate impacts in rural communities. For example, in October 2017, the Centers for Disease Control and Prevention (CDC) announced that the rates of overdose fatalities in rural areas surpassed those of urban areas.² The opioid epidemic has also fueled outbreaks of HIV and hepatitis C virus (HCV) infections among people who inject drugs (PWID). One such outbreak occurred in Scott County, Indiana, where 181 new cases of HIV were identified between November 2014 and October 2015.³ Ninety-two percent of these cases were coinfecting with HCV. These new infections were linked to the injection of prescription opioids and syringe sharing.^{3,4}

In the wake of the Scott County outbreak, 220 counties in 26 states were identified as

vulnerable to similar outbreaks. Notably, predominantly rural states bore a disproportionate burden of risk vulnerability. For example, 28 of the 55 counties in West Virginia were identified as vulnerable to opioid injection–related HIV and HCV outbreaks.⁵ Considering the breadth of the opioid epidemic, it is imperative that communities implement response strategies that are scaled to meet population-level needs. Unfortunately, few areas have up-to-date information regarding the size and characteristics of local PWID populations; this

creates significant challenges for strategic resource allocation (e.g., naloxone distribution programs, sterile injection equipment provision) and tailored program planning.

A variety of population estimation methodologies can be used to estimate the size of vulnerable populations.⁶ The capture and recapture (CRC) method has been widely used in public health, including among PWID, sex workers, and refugee populations.^{7–13} The CRC method can be applied directly via primary data collection with the target population or indirectly through use of existing data sources that contain members of the target population, such as disease registries and medical records.⁶ Direct applications of the CRC method involve 2 periods of data collection (the capture and recapture phases) in which members of the target population are counted. During the recapture phase, individuals who also participated in the capture phase are counted as “recaptures.” Count data for each study phase along with the number of recaptures can then be used to calculate a population size estimate.⁶ Although there are many examples of CRC methods being used to quantify the size and characteristics of vulnerable populations, most of these studies have used indirect approaches or occurred in urban environments.^{7,9–17} Little literature describes how this method can be applied directly in rural areas and among PWID populations.

This is an important gap in the research. Indirectly applying the CRC method in rural communities may be challenging because

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This article was accepted November 6, 2018.

doi: 10.2105/AJPH.2018.304873

AJPH METHODS

PWID are a hidden population and typically very few data sources (e.g., drug treatment registries) in rural communities can be used to calculate a population estimate. We have demonstrated how we applied direct CRC methods in a rural Appalachian community vulnerable to an opioid injection-related HIV and HCV outbreak (Cabell County, WV) to quantify the size and characteristics of the local PWID population.

METHODS

We conducted our CRC population estimation study in June and July 2018 in Cabell County, West Virginia. As of July 2017, there were an estimated 76 062 residents in Cabell County who were aged 18 years or older.¹⁸ Although Cabell County contains the city of Huntington, the US Census Bureau classifies 86.2% of its land space as rural.¹⁹ Cabell County also leads the state of West Virginia in heroin-related overdose fatalities and was identified as vulnerable to an HIV AND HCV outbreak.^{5,20}

Strategic Partner

We partnered with the Cabell-Huntington Health Department (CHHD) to implement our CRC population estimation study. The CHHD serves Cabell County and the City of Huntington, West Virginia, as a combined county and municipal local health department. In 2015, the CHHD partnered with more than 30 local community agencies and organizations to decrease the societal and personal harms associated with opioid use. A primary role for the health department was in the creation of a harm-reduction program, including syringe access services. Since opening in September 2015, the Cabell-Huntington Harm Reduction Program (CHHRP) has served an estimated 5000 individuals, dispensed nearly 12 000 doses of naloxone, and referred hundreds of individuals to substance use disorder treatment (M. E. Kilkenny, e-mail communication, August 28, 2018). The CHHRP is housed at the CHHD and operates 6 hours per day (9:00 AM to 3:00 PM), Monday through Friday. The CHHD was an ideal partner for our CRC study because of their existing relationships with the local PWID population, unique

position as the only harm-reduction services provider in the county, and their ability to serve as a data collection site during the capture phase (e.g., at the CHHRP).

Inclusion Criteria

Before implementing our CRC population estimation study, we engaged the CHHD in discussions surrounding local experiences PWID may have with law enforcement, accessing health care services, engaging in research studies, and disclosing personal information (e.g., drug use). We also discussed these topics with local PWID and those in recovery. From these conversations, we determined that PWID would be most receptive to our study if all data were collected anonymously. Furthermore, we determined that people may be reluctant to disclose injection drug use during the screening process because of stigma. As a result, we set our inclusion criteria broadly: (1) to be at least 18 years old, and (2) to have ever used drugs by any route of administration.

Survey Administration

We collected data anonymously through audio computer-assisted self-interview in which questions and answers were read to participants (in a female voice) via headphones to reduce bias.^{21–23} Everyone approached for participation in the study received a verbal description of the study and were given the opportunity to ask questions. Staff then verbally screened those who expressed interest in participating for eligibility. The survey included a diversity of measures, including those related to socio-demographics, substance use, experiences with drug treatment, and HIV and HCV risk behaviors (e.g., syringe sharing).

Data Collection Procedures

Capture phase. The capture phase occurred in June 2018 at the CHHRP and lasted 2 continuous weeks. We asked individuals who went to the CHHRP to participate in our study. Additionally, during the capture phase, the CHHD hosted a 1-day HIV testing event that was publicized at local community-based organizations frequented by PWID. We informed people who took part in the 1-day HIV testing event about our study, and we

invited those who expressed interest to be screened for participation. During the capture phase, all participants received a bright green bag filled with snacks as an incentive for their participation.

Recapture phase. The recapture phase focused on recruiting PWID from community locations where PWID congregate and commenced 2 weeks after the completion of the capture phase in July 2018. We identified recruitment locations via discussions with local stakeholders, including representatives from the CHHD, PWID who resided in Cabell County, and individuals in recovery who lived or worked in Cabell County. To supplement these data, we conducted a series of geospatial analyses to understand the relative distribution of injection drug use-related activities throughout Cabell County.

Using data provided by the West Virginia Department of Health and Human Resources, we created a heat map of overdose fatalities that occurred in 2016 in Cabell County. We created a heat map that reflected where the CHHD collected discarded syringes. We then reviewed publicly accessible media reports for mentions of drug crimes in Cabell County. We then analyzed location data from these reports, when available, in conjunction with the 2 heat maps to understand potential locations for participant recruitment. Collectively, these data sources afforded an in-depth understanding of where and when we could access the PWID population.

During the recapture phase, participants received a \$10 grocery gift card as an incentive for their participation. Notably, participants completed the survey during the recapture phase at a variety of venues, including public parks, transit locations, green spaces, neighborhoods known for drug-related activities, parking lots (apartments and businesses), gas stations, homeless encampments, on the stoops of abandoned properties, and on sidewalks. Staff also provided participants with collapsible stools to sit on (when needed) and umbrellas for shade to improve participant comfort while completing the survey.

Identifying recaptures. To accurately calculate the population size estimate, the survey included items that ascertained whether the participant had previously completed the

TABLE 1—Summary of People Who Inject Drugs (PWID) Population Estimation Data by Study Phase and Associated PWID Population Estimate: Cabell County, West Virginia, June–July 2018

	No. of PWID in Cabell County
Capture phase	194
Recapture phase	201
Total captures	395
Recaptures	21
Excluded ^a	1
Total unique PWID	373
Population estimate (95% CI)	1857 (1147, 2567)

Note. CI = confidence interval.

^aThe tablet overheated, and so the participant was unable to answer items regarding his or her previous participation in the study.

survey. During the capture phase, we asked participants, “Have you ever completed this survey before and received a bright green bag with food in it from the Cabell–Huntington Health Department?” In addition to this item, we asked participants in the recapture phase, “Have you ever completed this survey before and received a \$10 gift card to Kroger [a local grocery]?” We identified those who endorsed previously receiving the green snack bag during the capture phase and those who endorsed having previously received a grocery gift card during the recapture phase as repeat phase participants and removed them from the analyses to avoid duplication. We categorized those who endorsed having received the green bag during the recapture phase as “recounts,” meaning individuals who completed the survey during the capture and recapture phase.

Analyses

We analyzed data using SAS version 9.3 (SAS Institute, Cary, NC). We completed calculations for the population estimate using Microsoft Excel (Microsoft Corp., Redmond, WA) and executed them in accordance with the World Health Organization (WHO) and Joint United Nations Programme on HIV and AIDS (UNAIDS) *Guidelines on Estimating the Size of Populations Most at Risk to HIV*.⁶ We limited analyses to PWID who indicated Cabell County

residence and injection drug use in the past 6 months.

RESULTS

In total, 797 surveys were completed; of these surveys, 49.6% (n = 395) reflected PWID who reported injection drug use in the past 6 months and residence in Cabell County. Among these 395 surveys, we identified 21 recaptures and had to exclude 1 survey, as the tablet overheated and the participant was unable to answer items regarding his or her previous participation in the study, leaving 373 unique PWID (Table 1).

Of those 373 unique PWID who resided in Cabell County, most reported being White (83.4%), younger than 40 years (70.9%), male (59.5%), single (52.7%), unemployed (66.0%), and having health insurance (73.2%). Additionally, 28.3% reported having never completed high school and 30.6% reported having been arrested in the past 6 months. Current living situations varied, with 36.7% living in a place they own or rent followed by 21.2% living on the street and 20.6% residing at a family or friends house. Despite their current living situation, most participants considered themselves homeless (57.1%) and reported having gone to bed hungry at least 1 night per week (64.3%). These results are summarized in Table 2.

Among PWID surveyed, mean age of first injection was 24.9 years (Table 3). On average, participants reported injecting 4.5 times per day. Drugs most commonly injected in the past 6 months were heroin (82.0%), methamphetamine (71.0%), and fentanyl (56.3%). For drugs used in other forms (swallowed, smoked, or snorted), prescription pain medications (63.5%), marijuana (63.3%), cocaine (59.2%), and methamphetamine (54.4%) were most reported. When asked where PWID had obtained sterile syringes in the past 6 months, the majority reported from a needle exchange (66.0%). However, large proportions of PWID reported having reused injection equipment they knew had been used by someone else in the past 6 months, specifically syringes (41.0%), cookers (44.0%), cottons (35.9%), and rinse water (41.6%). A majority (57.4%) also reported having ever accessed services at the CHHRP. Seventy-

four percent reported having attempted to quit using drugs in the past 6 months.

During the recapture phase, we identified 21 individuals as recapture PWID who completed the survey during both data collection phases and reported being Cabell County residents. To calculate the population estimate, we used the following formula (as outlined in the WHO and UNAIDS *Guidelines on Estimating the Size of Populations Most at Risk to HIV*.⁶) in which C1 = capture phase count, C2 = recapture phase count, and M = recaptures:

$$(1) \quad \text{Population Estimate}(N) = \frac{(C1 \times C2)}{M}$$

We also calculated a 95% confidence interval (CI) for the population estimate using the following formula⁶: $95\% \text{ CI} = N \pm 1.96 \sqrt{\text{Var}(N)}$, where Var (N) is calculated as follows:

$$(2) \quad \text{Var}(N) = \frac{((C1 \times C2)(C1 - M)(C2 - M))}{(M^3)}$$

Substituting the number of PWID surveyed in the capture and recapture phases (C1 = 194 and C2 = 201, respectively) and the number of recaptures (M = 21) into the formulas above, we estimated a population of 1857 (95% CI = 1147, 2567) PWID who are also Cabell County residents. These data reflect an estimated 2.4% population prevalence of injection drug use in the past 6 months among Cabell County residents aged 18 years or older.

DISCUSSION

The results of our study demonstrate that direct CRC methods can be applied in rural Appalachia to estimate the size and characteristics of PWID populations. We estimated that approximately 1900 PWID reside in Cabell County, reflecting 2.4% of individuals aged 18 years or older. This research fills an important gap in the public health literature, as scant population-level data exist for rural PWID, particularly among those who reside in counties the CDC identified as vulnerable to an opioid injection-related HIV and HCV outbreak. These data are critically important

TABLE 2—Sociodemographics of People Who Inject Drugs (PWID) Residing in Cabell County, West Virginia: June–July 2018

Characteristic	No. (%)
Race/ethnicity	
Non-Hispanic White	302 (83.4)
Non-Hispanic Black	9 (2.5)
Hispanic, any race	24 (6.6)
Other	27 (7.5)
Age, y	
18–29	95 (25.5)
30–39	169 (45.4)
40–49	77 (20.7)
50–59	28 (7.5)
≥ 60	3 (0.8)
Gender	
Male	222 (59.5)
Female	151 (40.5)
Relationship status	
Single	195 (52.7)
In a relationship/married	175 (47.3)
Currently has health insurance	273 (73.2)
Education	
Did not finish high school	105 (28.3)
High school graduate or GED	128 (34.5)
Some college	91 (24.5)
Bachelor's or associate's degree	33 (8.9)
Some graduate school	14 (3.8)
Arrested in the past 6 mo	114 (30.6)
Current living situation	
Place that you own or rent	137 (36.7)
Family or friend's home	77 (20.6)
Shelter or other temporary housing	34 (9.1)
On the street	79 (21.2)
Other	46 (12.3)
Considers self homeless	213 (57.1)
Goes to bed hungry at least once per week	240 (64.3)
Unemployed	246 (66.0)

Note. GED = general equivalency diploma. Denominator was n = 373.

for informing and tailoring opioid epidemic response strategies, as they provide insights into the number of PWID and their needs for services and current levels of access. For example, our finding that more than half of PWID reported injecting fentanyl can be used to inform naloxone distribution campaigns and other overdose prevention initiatives.

These data also have significant implications for HIV-prevention initiatives.

Considering the recency with which harm-reduction services were implemented in Cabell County and the amount of time it takes to establish rapport and trust with PWID populations, the fact that most PWID reported having accessed harm-reduction services at the CHHRP is commendable. However, work remains to be done, as large proportions of PWID reported reusing injection equipment they knew had been used by someone else. Additionally, the high prevalence of heroin and methamphetamine injection could increase community-level vulnerability to an HIV outbreak, as research has shown that PWID who report injecting both drugs are more likely to inject with greater frequency and reuse syringes than are their counterparts who inject only heroin or only methamphetamine.²⁴ Future work should explore how to further reduce risky injection practices among rural PWID, particularly those who inject both heroin and methamphetamine. Research should also be conducted to understand the factors driving the high prevalence of methamphetamine injection.

We learned several lessons throughout our application of CRC methods in this setting. Using heat maps of overdose fatalities and locations of syringe disposal was very useful in identifying specific locations where we may engage PWID in the community. Heat maps were also an unobtrusive strategy for garnering an understanding of the geotemporal distribution of PWID in the county. Stakeholder discussions about where and when to engage the target population were equally useful because of the fluidity of where and when PWID congregate. Relatedly, stakeholder discussions provided valuable insights into safety issues in each venue. We also learned that using multiple data sources is critically important to fully understanding the times and locations where PWID may be encountered and that 1 data source should not be considered superior, as each made unique contributions to our understanding of the geotemporal distribution of PWID.

In terms of systematically covering the identified areas for recruitment, we learned that providing staff with maps of relatively small, defined geographic areas was superior to providing them with specific walking directions based on street intersections, as staff found this method time consuming and often

low yield if few people were in the target area. We also learned that when recruiting PWID in remote rural areas, it is useful to first conduct windshield tours of the target areas to determine whether they are viable areas for recruitment rather than sending out data collection teams. Additionally, we learned that recruiting PWID in very remote areas requires more time than does recruiting their counterparts in areas with public venues and shopping areas.

Branding our study in brightly colored T-shirts and related attire allowed rapid recruitment, as PWID were able to easily identify study staff. It also enhanced our ability to engage with PWID via word of mouth; for instance, individuals knew to look for people in bright green shirts or hats if they wanted to participate. In terms of data collection, participants reported to study staff that audio computer-assisted self-interview made them more comfortable than potentially answering the survey items verbally.

Limitations and Strengths

Our findings are not without limitations. Although we were able to estimate the number of PWID who reside in Cabell County, we were not able to ascertain the number of nonresident PWID who engage in activities in Cabell County. As a result, our population estimate should be viewed as an underestimate of the overall number of PWID in Cabell County. Because we collected data during periods of high heat and humidity, it is also possible some PWID were not surveyed, as they could have been in locations that were not readily accessible, such as inside air-conditioned homes. However, we feel this is a minor limitation considering the number of days and times we collected data. Additionally, although we generally found that people were highly receptive to participating in our study, a small number declined participation. A further limitation pertains to accessing portions of the PWID population who reside in very remote areas. A few locations were not viable areas for recruitment, as they lacked public venues, sidewalks, and other areas where we could reasonably interact with individuals. An additional limitation is that we were unable to ascertain how individuals knew they were using fentanyl; future work should explore

TABLE 3—Substance Use Measures Among People Who Inject Drugs (PWID) Residing in Cabell County, West Virginia: June–July 2018

Variable	No. (%)
Age, y of injection initiation, mean (SD)	24.9 (8.8)
No. of injections per d, mean (SD)	4.5 (5.4)
Drugs injected, past 6 mo	
Heroin	306 (82.0)
Methamphetamine	265 (71.0)
Fentanyl	210 (56.3)
Speedball (co injection of heroin and cocaine)	141 (37.8)
Cocaine	132 (35.4)
Buprenorphine/Suboxone	111 (29.8)
Prescription pain medications	81 (21.7)
Noninjected drugs used, past 6 mo	
Prescription pain medications	237 (63.5)
Marijuana	236 (63.3)
Cocaine	221 (59.2)
Methamphetamine	203 (54.4)
Heroin	121 (32.4)
Where obtained sterile syringes, past 6 mo	
From a needle exchange	246 (66.0)
From a friend	139 (37.3)
Bought from a person	132 (35.4)
Bought from a store, pharmacy, or online	51 (13.7)
Reused injection equipment used by someone else, past 6 mo	
Syringes	153 (41.0)
Cookers	164 (44.0)
Cottons	134 (35.9)
Rinse water	155 (41.6)
Attempted to quit using drugs in past 6 mo	277 (74.3)
Ever accessed harm-reduction services at the CHHRP	214 (57.4)

Note. CHHRP = Cabell-Huntington Harm Reduction Program. Denominator was n = 373.

whether individuals are intentionally seeking out fentanyl.

Despite these limitations, the study was characterized by numerous strengths. We were able to access a large number of PWID for this research, enhancing the representativeness of our findings. Our use of memorable incentives during each study phase allowed participants to easily remember whether they had previously engaged in our study. Relatedly, our study branding afforded expeditious dissemination of information about our study among the target population, as individuals learned from their

peers to look for people in bright green shirts if they wanted to participate in the study.

An additional strength of our study was our partnership with the CHHD. The CHHD has a long history of providing services to PWID and is a trusted entity among the population, allowing us to access PWID who may have otherwise been reluctant to participate.

Conclusions

Direct CRC methods can be applied in rural communities to estimate the size and characteristics of PWID populations. Our research fills an important gap in the public health literature because of the rapid expansion of the opioid epidemic into rural communities and lack of studies that explore how population estimation methods can be implemented in rural areas. Our findings provide important information about the local PWID population that can be used to guide policy discussions, allocate resources strategically, and scale up existing opioid epidemic response initiatives. *AJPH*

CONTRIBUTORS

S. T. Allen conceptualized this research. S. T. Allen, A. O'Rourke, R. H. White, and K. E. Schneider oversaw the study implementation. S. T. Allen, A. O'Rourke, and R. H. White conducted the analyses. M. Kilkenny and S. G. Sherman supported instrumentation and the development of data collection strategies. All authors were involved in the interpretation of the findings and article development.

ACKNOWLEDGMENTS

This research was supported by the Bloomberg American Health Initiative at the Johns Hopkins Bloomberg School of Public Health. This research has been facilitated by the infrastructure and resources provided by the Johns Hopkins University Center for AIDS Research, a National Institutes of Health (NIH)-funded program (grant P30AI094189). S. T. Allen is also supported by the NIH (grant K01DA046234). K. E. Schneider is supported by the National Institute on Drug Abuse (grant 5T32DA007292-25).

We are grateful for the collaboration of the Cabell-Huntington Health Department, without which this project would not have been possible. We are especially grateful to Tim Hazelett, Thommy Hill, Tyler Deering, Kathleen Napier, Jeff Keatley, Michelle Perdue, Chad Helig, and Charles "CK" Babcock for all their support throughout the study implementation. We are also grateful for the hard work of the West Virginia COUNTS! research team: Megan Keith, Anne Maynard, Aspen McCorkle, Terrance Purnell, Ronaldo Ramirez, Kayla Rodriguez, Lauren Shappell, Brad Silberzahn, Dominic Thomas, Kevin Williams, and Hayat Yusuf. We gratefully acknowledge the West Virginia Department of Health and Human Resources. We also wish to acknowledge Josh Sharfstein, Michelle Spencer, Dori Henry, and Akola Francis for their support throughout each phase of the study. Most importantly, we are grateful to our study participants.

Note. The funders had no role in study design, data collection, or in analysis and interpretation of the results, and this article does not necessarily reflect views or opinions of the funders.

CONFLICTS OF INTEREST

None of the authors has any conflicts of interest.

HUMAN PARTICIPANT PROTECTION

The study was approved by the Johns Hopkins University institutional review board.

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